

Before the  
Federal Communications Commission  
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 2 and 25 of the	)	ET Docket No. 98-206
Commission's Rules to Permit Operation	)	RM-9147
of NGSO FSS Systems Co-Frequency with	)	RM-9245
GSO and Terrestrial Systems in the Ku-	)	
Band Frequency Range	)	
and	)	
Amendment of the Commission's Rules	)	
to Authorize Subsidiary Terrestrial Use	)	
of the 12.2-12.7 GHz Band by Direct	)	
Broadcast Satellite Licensees and Their	)	
Affiliates	)	
	)	

**NOTICE OF PROPOSED RULEMAKING**

**Adopted:** November 19, 1998

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By the Commission: Commissioner Ness issuing a statement.

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## I. INTRODUCTION

1. In this Notice of Proposed Rulemaking ("Notice"), we propose to permit non-geostationary satellite orbit ("NGSO") fixed-satellite service ("FSS") operations<sup>1</sup> in certain segments of the Ku-band<sup>2</sup> and propose rules and policies to govern such operations. We also

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<sup>1</sup> NGSO satellite systems, such as proposed by SkyBridge, are characterized by a constellation of satellites continuously orbiting the earth, rather than appearing to remain stationary relative to a user as a geostationary satellite does. NGSO satellites generally operate at lower altitudes and therefore appear to move from horizon to horizon. As the NGSO satellites move through their orbit, they transmit to and receive from earth stations that are in view of the satellite. Geostationary satellites orbit 22,300 miles above the Earth in the plane of the Earth's equator. At this altitude, the geostationary satellite's position appears fixed relative to an observer on the Earth.

<sup>2</sup> The Ku-band generally refers to frequencies within the 12 GHz to 18 GHz range. The specific bands subject to this proceeding are the 10.7-12.7 GHz, 12.75-13.25 GHz, 13.75-14.5 GHz, and 17.3-17.8 GHz bands. For the purposes of this proceeding, we use the term "Ku-band" to refer generally to all of the frequency bands listed above that are under consideration in this proceeding.

propose or seek comment on, technical criteria to ensure that such NGSO FSS operations do not cause unacceptable interference to existing users or do not unduly constrain future growth of incumbent services. Specifically, we ask commenters to analyze the spectrum sharing criteria developed at the 1997 International Telecommunication Union ("ITU") World Radiocommunication Conference ("WRC-97")<sup>3</sup> to permit NGSO FSS operations in various segments of the Ku-band, and address whether these proposals are adequate to protect existing services in the Ku-band from unacceptable interference from NGSO FSS operations. In addition, we request comment on a petition to permit terrestrial use of the 12.2-12.7 GHz band for the retransmission of local television and provision of one-way data services by direct broadcast satellite ("DBS") service operators and their affiliates. This action responds to petitions filed by SkyBridge L.L.C. ("SkyBridge") and Northpoint Technology ("Northpoint").

## II. BACKGROUND

### 1. SkyBridge Petition and Application

2. On July 3, 1997, SkyBridge filed a Petition for Rulemaking ("Petition") requesting that the Commission amend Parts 2 and 25 of its rules to permit NGSO FSS systems to operate in the United States ("U.S.") in the 10.7-12.7 GHz band for NGSO space-to-earth links ("downlinks") (a total of 2 gigahertz) and in the 12.75-13.25 GHz, 13.75-14.5 GHz, and 17.3-17.8 GHz bands for NGSO earth-to-space links ("uplinks") (a total of 1.75 gigahertz). The requested downlink bands are generally used by geostationary-satellite orbit ("GSO") FSS, DBS and fixed services. The requested uplink bands are used by GSO FSS operations, fixed services, mobile services, and Government operations. SkyBridge states that NGSO FSS systems should be permitted to operate in these bands according to the following conditions: 1) NGSO FSS systems operating in these bands would cause no noticeable degradation to the quality of service or availability of GSO satellite operations and terrestrial links, and 2) NGSO FSS systems operating in these bands would impose no operational constraints on GSO satellite and terrestrial operators.<sup>4</sup> SkyBridge proposes technical criteria which it claims would protect GSO satellite and terrestrial operations in these bands from interference from NGSO FSS systems. SkyBridge states that its proposal would provide advanced satellite services to the public and increase competition within the broadband market without having to dedicate additional spectrum resources to this end.<sup>5</sup> By using NGSO satellites that operate in the Ku-band with lower earth orbits, SkyBridge expects that its system's propagation times would be similar to those for landline broadband transmission systems, and the costs for some key items, such as user terminals, would be similar to those for GSO FSS systems.

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<sup>3</sup> See *Final Acts of the 1997 World Radiocommunication Conference ("Final Acts of WRC-97")*; Article S21, Article S22, Resolution 130, Resolution 131, Resolution 538 (Geneva, 1997).

<sup>4</sup> See SkyBridge Petition, RM-9147, filed July 3, 1997, at 2.

<sup>5</sup> See SkyBridge Petition at 3.

3. In addition to its Petition, SkyBridge filed an application for authority to launch and operate an NGSO FSS system.<sup>6</sup> SkyBridge's application requests use of 1.05 gigahertz of spectrum for its uplink transmissions and use of 1.05 gigahertz for its downlink transmissions.<sup>7</sup> For its system, SkyBridge proposes a constellation of 80 satellites operating in non-geostationary satellite orbit. The system is organized as two satellite sub-constellations, providing continuous global coverage between +68 degrees and -68 degrees latitude. The satellites would communicate with users and then forward all communications to a limited number of regional gateway earth stations. All switching and routing would occur through such gateway stations. The SkyBridge gateway earth stations would control the routing of information within the SkyBridge system and connect users to terrestrial telecommunications networks (via the NGSO satellite hops). SkyBridge anticipates placing thirty to forty gateway stations in the U.S., each serving an area of approximately 350 km radius. SkyBridge contends that its system would provide high-speed Internet and on-line access services, video conferencing and telephony, entertainment services, interactive video on demand, and a variety of substitutes for terrestrial infrastructure links. SkyBridge states that at least one satellite would be visible at all times within the coverage area of a gateway, although two or more satellites may be visible at many gateway locations. While this proceeding focuses on NGSO FSS systems in general and discusses certain characteristics of the proposed SkyBridge system, SkyBridge's application will be addressed in a separate, future proceeding.<sup>8</sup>

4. *WRC-97/2000.* To promote spectrum sharing between NGSO systems and other services, WRC-97 adopted power flux density ("pfd"), provisional equivalent power flux-density ("epfd") and provisional aggregate power flux density ("apfd") limits for certain segments of the Ku and Ka-bands.<sup>9</sup> Pfd is a measure of the amount of energy emitted by a transmitter that is present over a unit area at the Earth's surface or at the satellite, and it is a critical factor in determining whether satellite systems can successfully share spectrum with other services or

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<sup>6</sup> SkyBridge Application, File No. 48-SAT-P/LA-97, February 28, 1997; Amendment, File No. 89-SAT-AMEND-97, July 2, 1997 (SkyBridge Application). SkyBridge initially proposed 64 NGSO satellites for its system, but subsequently amended its application to increase the number to 80 NGSO satellites.

<sup>7</sup> See SkyBridge Application at 4.

<sup>8</sup> We note that the Commission issued a public notice establishing a cut-off for competing NGSO FSS applications to be considered in the Ku-band. See, *infra* Section C.

<sup>9</sup> See *supra*, n.3 (*Final Acts of WRC-97*). WRC-97 adopted Resolutions 130, 131 and 538 to further address technical, operational and regulatory issues relating to accommodating NGSO FSS in the Ku and Ka bands. Resolution 130 (WRC-97) relates to the use of NGSO systems in certain FSS bands. Resolution 131 (WRC-97) relates to pfd limits applied to NGSO FSS systems to protect terrestrial services in the 10.7-12.75 GHz and 17.7-19.3 GHz bands. Finally, Resolution 538 (WRC-97) relates to use of planned broadcasting-satellite service bands (covered by Appendices 30 and 30A of the international Radio Regulations) by NGSO FSS systems. The Ka-band generally refers to the 17.7-20.2 GHz (downlink) and 27.5-30.0 GHz (uplink) bands. The Commission will address sharing between NGSO FSS and GSO FSS, and NGSO FSS and terrestrial services, in the Ka-band in a separate proceeding.

satellite systems. Epfd is the sum of the power levels of all possible interfering transmissions from all satellites in a particular NGSO constellation into a particular GSO earth station receiver.<sup>10</sup> Epfd limits are intended to control the level of signal energy on the earth's surface. Because each epfd limit applies to a particular GSO earth station receiver with a specific antenna diameter and sidelobe pattern, different GSO FSS earth station receivers may require different epfd protection requirements. Apfd is the sum of the power levels at a location on the GSO arc created by all visible earth station transmitters in an NGSO system.<sup>11</sup>

5. To protect incumbent GSO FSS and broadcasting-satellite service ("BSS")<sup>12</sup> operations in the Ku-band, WRC-97 adopted provisional<sup>13</sup> epfd and apfd limits. Because the technical studies justifying the WRC-97 NGSO action had not been fully studied in the usual ITU Radiocommunication Sector ("ITU-R") study group process,<sup>14</sup> these epfd and apfd limits were deemed provisional until they could be analyzed by the relevant ITU-R study groups and reviewed at WRC-2000. Based on the results of the ITU-R study group analyses, administrations at WRC-2000 will confirm or revise the epfd and apfd limits. The epfd and apfd limits adopted by WRC-97 only apply, however, to a single NGSO FSS system ("single-entry" limits) and do not consider the impact of multiple NGSO systems. Further, the WRC-97 epfd and apfd limits include short term (sidelobe to mainbeam interference) and long term (sidelobe to sidelobe and backlobe interference) protection requirements.<sup>15</sup> Finally, WRC-97 also adopted limits for GSO

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<sup>10</sup> A traditional pfd limit is not necessarily appropriate for potential interference from an NGSO FSS system into a GSO FSS network, as it does not take into account the aggregate effect of the many satellites within a NGSO system that may transmit into a GSO earth station receiver.

<sup>11</sup> The WRC-97 definition of apfd does not take into account the GSO satellite antenna directivity.

<sup>12</sup> WRC-97 also allocated the 12.2-12.7 GHz band on a primary basis to NGSO FSS in Region 2.

<sup>13</sup> In accordance with Resolutions 130 and 538, if the epfd/apfd limits are modified at WRC-2000, an NGSO FSS system is required to conform to the epfd/apfd limits adopted by WRC-2000, regardless of whether information regarding the NGSO FSS system has already been submitted to the ITU or whether the system has been brought into use.

<sup>14</sup> The ITU-R organizes study groups to undertake technical studies that, among other things, can form the basis for technical decisions to be taken at WRCs. These study groups are organized generally along service categories. For highly technical issues the customary practice is that administrations submit technical papers to the appropriate study group, or, in some cases, joint study groups, where those papers are analyzed and either agreed to or modified. The end product is a technical recommendation by the study group on the issue or issues that were submitted for review.

<sup>15</sup> Short-term interference is caused by signals from the NGSO space station antenna sidelobe into the antenna mainbeam of the GSO earth station receiver and from the NGSO space station antenna mainbeam into the sidelobe of the GSO FSS earth station receive antenna. These interference occurrences are typically for a short period of time and are at a higher power level (*i.e.*, comparable or higher than the total GSO FSS satellite link noise). Therefore, the WRC-97 short term interference criteria includes a percentage of time which the NGSO operation cannot exceed

earth station off-axis equivalent isotropically radiated power ("eirp") density to facilitate sharing among the allocated services. However, these limits were subsequently suspended by WRC-97 and will be reviewed by WRC-2000. If approved at WRC-2000, these limits would require GSO earth stations to limit their energy beyond what is currently required for GSO-GSO sharing in the equatorial plane.

6. To protect terrestrial services and facilitate spectrum sharing between satellite systems and terrestrial receivers, the international Radio Regulations include pfd limits to control the level of satellite signal energy on the Earth's surface.<sup>16</sup> Although the pfd limits currently in use were developed to protect terrestrial services from GSO satellite downlink transmissions, WRC-97 concluded that these limits should also apply to NGSO satellite transmissions. While the pfds to protect terrestrial services from NGSO FSS are not provisional,<sup>17</sup> they are subject to review and possible modification at WRC-2000 to determine whether they adequately protect terrestrial services from NGSO FSS transmissions.

7. Joint Task Group ("JTG") 4-9-11, in which the U.S. participates, is conducting technical analyses of these sharing issues in preparation for WRC-2000.<sup>18</sup> The JTG 4-9-11, as well as each of the other relevant ITU-R working groups, have met twice since WRC-97 and the comments on SkyBridge's Petition were filed. As a result, significant progress on NGSO/GSO

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the short term limit. Long term interference is caused by signals emitted from NGSO space station antenna sidelobes to the side and backlobes of the GSO earth station receiver. Long term interference would be present at all times (*i.e.*, whenever an NGSO uplink or downlink transmit is within view) and are essentially at a constant power level, which is lower than the short-term interference level. In other words, long term interference accounts for the overall increase in a GSO system's noise floor caused by an NGSO system and short term interference occurs when an NGSO system temporarily generates higher levels of interference (*e.g.*, transmitting into the mainbeam of a GSO earth station receiver).

<sup>16</sup> The pfd limits to protect terrestrial services from satellite operations are different from the epfd and apfd limits used to protect GSO operations from NGSO operations in that a pfd limit applies to each NGSO FSS satellite independently, whereas an epfd or apfd limit applies aggregately from all the satellites or earth stations in the NGSO FSS system, respectively.

<sup>17</sup> The pfd limits to protect Ku-band terrestrial services are not provisional, except for the NGSO FSS pfd limits in the 17.7-17.8 GHz band. Thus, NGSO FSS systems authorized prior to WRC-2000 must conform to the pfd levels adopted by WRC-97. If the pfd levels are modified at WRC-2000, however, NGSO FSS systems authorized after the new limits are effective would conform to the new limits.

<sup>18</sup> Following WRC-97, ITU-R JTG 4-9-11 was created to analyze NGSO FSS sharing with GSO FSS, fixed service and GSO BSS services in the Ku and Ka bands. The numbers "4", "9," and "11" refer to ITU-R study group designations: 4 - fixed satellite; 9 - fixed service; and 11 - broadcasting (television).

sharing issues has been made.<sup>19</sup> Further, we highlight that studies on these issues are ongoing in the ITU-R. We will consider the outcome of this international work, and particularly WRC-2000, for possible domestic NGSO FSS operations. The results of WRC-97 and implications of these results will be discussed in detail below.

## 2. Northpoint Petition

8. On March 6, 1998, Northpoint filed a Petition for Rulemaking with the Commission aimed at providing terrestrial retransmission of local television signals and one-way data services to DBS receivers in the 12.2-12.7 GHz band on a secondary basis to BSS operations.<sup>20</sup> Northpoint states that its proposal would allow DBS subscribers to receive local television programming and one-way data services with minimal additional equipment and thus would permit the DBS service to compete more fully with cable television services. Because Northpoint is requesting that its terrestrial services be permitted to operate in some of the same spectrum requested by SkyBridge, we are addressing both petitions in this proceeding.

## III. DISCUSSION

9. We undertake this proceeding to address the spectrum sharing issues presented by SkyBridge's and Northpoint's proposed use of spectrum in the Ku-band range. If adopted, these proposals could increase competition and provide new advanced services to the public. Specifically, SkyBridge's proposal could provide new high-speed data services and offer additional competition to other satellite services, and terrestrial wireless and wireline services. Similarly, Northpoint's proposal could provide local video and new one-way data services and facilitate competition to cable television systems. There is, however, extensive use of the requested frequency bands in the U.S. and these incumbent operations provide important and valuable services to the public. Accordingly, while we desire to promote competition and innovation by allowing for new services or additional spectrum use, we also need to consider the competing interests of the incumbent services in these bands.

10. The following tables provide a concise summary of the existing U.S. incumbent

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<sup>19</sup> See, e.g., *Preliminary Draft New Recommendation on the Maximum Allowable Values of PFD Produced at the Earth's Surface by NGSO satellites in the FSS operating in the 10.7-12.75 GHz band*, Document 4-9S/TEMP/73, October 2, 1998; *Preliminary Draft New Recommendation on Protection of FSS networks using slightly-inclined GSOs from all other FSS systems*, Document 4A/TEMP/72, October 9, 1998; *Preliminary Draft New Recommendation on the Protection of the Broadcasting-Satellite Service in the 12 GHz band and Associated Feeder links in the 17 GHz Band from Interference Caused by NGSO FSS Systems*, Document 10-11S/TEMP/41, October 12, 1998.

<sup>20</sup> Northpoint Petition for Rulemaking, RM-9245, filed March 6, 1998. On March 23, 1998, the Commission issued a Public Notice inviting comment on the Northpoint petition. *Public Notice*, Report No. 2265, March 23, 1998.



operations, the SkyBridge proposals for downlink and uplink NGSO FSS operations, and the Northpoint proposal.

U. S. Incumbent Operations and SkyBridge (Downlink) and Northpoint Requests

Band <sup>21</sup>	10.7-11.7 GHz	11.7-12.2 GHz	12.2-12.7 GHz
Incumbent Operations	FIXED	FSS DOWNLINK	BSS <sup>22</sup>
	FSS DOWNLINK	Mobile	FIXED
<i>Northpoint Proposal</i>			<i>Fixed (video and data service)</i>
<i>SkyBridge Proposal</i>	<i>NGSO GATEWAY</i>	<i>NGSO SERVICE LINKS</i>	<i>NGSO SERVICE LINKS</i>

<sup>21</sup> Primary services are listed in capital letters. Lower-case letters indicate secondary services. Primary services in a particular frequency band have equal rights to any other services operating in the same band. Stations operating in primary services are protected against interference from stations of "secondary" services. Moreover, stations operating in a secondary service cannot claim protection from harmful interference from stations of a primary service. See 47 C.F.R. §§ 2.104(d), 2.105(c).

<sup>22</sup> BSS, by definition, is in the downlink direction only. The corresponding feeder link frequencies for BSS are in FSS uplink allocations.

## U. S. Incumbent Operations and SkyBridge (Uplink) Requests

Band	12.75-13.25	13.75-14.0	14.0-14.2	14.2-14.4	14.4-14.5	17.3-17.7	17.7-17.8
Incumbent Operations	FIXED	GOVT. RADIO-LOCATION	FSS UPLINK	FSS UPLINK	FSS UPLINK	FSS UPLINK <sup>23</sup>	FIXED
	FSS UPLINK	FSS UPLINK	Govt. Radio-navigation <sup>24</sup>	Mobile	Radio Astronomy <sup>25</sup>		FSS UPLINK <sup>23</sup>
	MOBILE	Standard Freq & Time Signal-Satellite	Non-Govt. Radio Navigation <sup>25</sup>	Land Mobile Satellite Uplink	Land Mobile Satellite Uplink	Govt. Radio-location	MOBILE
	SPACE RESEARCH (deep space) <sup>26</sup>	SPACE RESEARCH <sup>27</sup>	Land Mobile Satellite Uplink		Govt. Mobile		FSS DOWNLINK
			Space Research		Govt. Fixed		
<i>SkyBridge Proposal</i>	<i>NGSO GATEWAY</i>	<i>NGSO GATEWAY</i>	<i>NGSO SERVICE LINKS</i>	<i>NGSO SERVICE LINKS<sup>28</sup></i>	<i>NGSO GATEWAY</i>	<i>NGSO GATEWAY</i>	<i>NGSO GATEWAY</i>

<sup>23</sup> US271 limits use of this band 17.3-17.8 GHz by FSS (Earth to space) to feeder links for BSS. See 47 C.F.R. § 2.106 n. US271.

<sup>24</sup> See 47 C.F.R. § 2.106 n. US292.

<sup>25</sup> See 47 C.F.R. § 2.106 n. 862, US203.

<sup>26</sup> Footnote US251 limits these operations to Goldstone, CA.

<sup>27</sup> The space research service allocations are to both communications and radar operations. See 47 C.F.R. § 2.106 n. S5.503, S5.503A, US337.

<sup>28</sup> SkyBridge also proposes to allow NGSO FSS gateway operations in the 14.2-14.4 GHz band.

11. *NGSO Proposals.* While our decisions in this proceeding will ultimately determine whether NGSO FSS systems, including earth stations, will be licensed to operate in the U.S. in these bands, we recognize that NGSO FSS satellites authorized by other countries under international criteria could transmit signals over North America, especially when serving neighboring countries. The NGSO FSS proposals require that we analyze the technical sharing issues in the Ku-band, and are committed to doing so. The U.S. participates actively in the work of the JTG 4-9-11 in analyzing these sharing issues. Nonetheless, ITU-R study group deliberations are based on the technical input of many administrations that often have different domestic spectrum uses that result in different potentials for spectrum sharing. The conclusions of the study group may have general technical applicability, based on each administration's input and the resultant compromise, but may not adequately address specific, domestic sharing conditions. Consequently, it is essential that we develop in this proceeding an independent record regarding the possibility of implementing NGSO FSS in the U.S., given our unique and extensive use of the Ku-band. By doing so, we will be able to develop and, if appropriate, adopt technical limits and spectrum sharing criteria suitable for domestic NGSO FSS operations. In this Notice, we will refer at times to issues being addressed by the JTG 4-9-11, and we may include in this docket contributions to the JTG 4-9-11, as appropriate, so that parties to this proceeding may comment on them. In this way, we expect to develop an extensive and comprehensive record of the various sharing issues under consideration domestically and internationally.

12. The U.S. also has obligations under the World Trade Organization ("WTO") Basic Agreement on Telecommunications.<sup>29</sup> In a recent Report and Order, we set forth our policies implementing the commitments made by the U.S.<sup>30</sup> In that Report and Order, we addressed the issue of spectrum availability. We stated that spectrum availability concerns often impact the licensing process, as applications for spectrum assignments often exceed available spectrum. We committed to follow procedures that are transparent and nondiscriminatory, treating applications by non-U.S. entities the same way we treat applications by U.S. entities, regardless of whether this resulted in granting the applicant's request.<sup>31</sup> We intend to uphold these commitments in this proceeding where spectrum availability is a significant concern. Although spectrum has been allocated on an international basis for NGSO FSS systems, incumbent services (e.g., GSO FSS, BSS, fixed service and government system operations) in the Ku-band in the U.S. create unique

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<sup>29</sup> See Fourth Protocol to the General Agreement on Trade in Services (April 30, 1996), 36 I.L.M. 336 (1997).

<sup>30</sup> See *Amendment of the Commission's Regulatory Policies to Allow Non-U.S. Licensed Space Stations to Provide Domestic and International Satellite Service in the United States, Amendment of Section 25.131 of the Commission's Rules and Regulations to Eliminate the Licensing Requirement for Certain International Receive-Only Earth Stations, Communications Satellite Corporation Request for Waiver of Section 25.131(j)(1) of the Commission's Rules as it Applies to Services Provided via the INTELSAT K Satellite, Report and Order ("DISCO II R&O")*, IB Docket No. 97-111, 12 FCC Rcd 24094 (1997).

<sup>31</sup> See *DISCO II R&O* at ¶149.

problems for assigning NGSO FSS systems to the Ku-band domestically, regardless of nationality of the operator.

13. Further, while we are not considering the grant of SkyBridge's license application in this proceeding, we will refer to some of the technical aspects of and comments on the SkyBridge application in order to facilitate developing a more complete record. The purpose of this proceeding is to consider generally whether multiple NGSO FSS systems can share the Ku-band with each other and with FSS, BSS, fixed service and government incumbent operations. Thus, we ask interested parties to file comments that will enable us to make technically accurate and fair decisions regarding all potential NGSO FSS operations in the Ku-band and their impact on all incumbent operations.

#### A. NGSO FSS Gateway Bands

14. In the following discussion, we consider each of the bands proposed for NGSO FSS gateway operations and their viability for sharing with other services. We tentatively propose to allow NGSO FSS gateway downlink operations on a co-primary basis in the 10.7-11.7 GHz band; and allow NGSO FSS gateway uplink operations on a co-primary basis in the 12.75-13.25 GHz, 13.8-14.0 GHz, and 14.4-14.5 GHz bands. In addition, we propose to adopt the WRC-97 pfd limits, and coordination and other procedures to facilitate sharing between NGSO operations and terrestrial services. In light of the ongoing JTG 4-9-11 meetings, we seek comment regarding the WRC-97 provisional epfd and apfd limits for NGSO sharing with GSO operations and request thorough analysis concerning the adequacy of these limits. Further, we do not propose to allow NGSO FSS gateway uplink operations in the 13.75-13.8 GHz band due to potential interference with Government operations and the 17.3-17.8 GHz band because of a conflict with use of this band for BSS and radiolocation services.<sup>32</sup> A discussion of each of the gateway bands is provided below. Additional technical issues affecting these proposals (*e.g.*, multiple NGSO systems, antenna reference pattern requirements and others) are discussed in Section D below and should be taken into account when addressing issues in this section.

15. For the purpose of NGSO FSS in the Ku-band, we propose that gateway operations should be defined as earth station operations that are not intended to originate and terminate traffic but are primarily intended for interconnecting to other networks. A gateway complex may include multiple antennas, and each would be required to meet the antenna performance standards specified in Section D below. Further, the multiple antennas in a gateway complex must be located within a one second latitude and longitude square. We request comment on this NGSO FSS gateway definition, whether a minimum antenna size requirement also should be adopted for NGSO FSS gateway earth stations in the Ku-band, in particular, to facilitate sharing with the

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<sup>32</sup> See Letter from William T. Hatch, Interdepartmental Radio Advisory Committee ("IRAC") Chairman, to Mr. Dale Hatfield, Chief, Office of Engineering and Technology, dated October 29, 1998, and placed in the record in this proceeding. This letter contains comments from the Office of the Assistant Secretary of Defense and will be referred to as the "DoD comments."

terrestrial services. Further, should the number of NGSO FSS gateways per system be limited to facilitate sharing with terrestrial services.

#### 1. NGSO Gateway Downlink Band (10.7-11.7 GHz)

16. *Current allocations.* SkyBridge proposes to use the 10.7-11.7 GHz band for gateway downlinks. The 10.7-11.7 GHz band is currently allocated on a co-primary basis to the fixed service, licensed under Part 101 of the Commission's rules, and to the FSS for international systems (downlinks),<sup>33</sup> licensed under Part 25 of the Commission's rules.<sup>34</sup> There are more than 32,000 terrestrial fixed links in the 10.7-11.7 GHz band. These links support a wide array of communication services used by utilities, railroads, telephone companies, state and local governments, public safety agencies, and others.<sup>35</sup> Moreover, this band was identified in 1993 in the Emerging Technologies proceeding and in 1997 the mobile satellite service ("MSS") 2 GHz allocation proceeding as a future home for fixed point-to-point operations to be relocated from the 2 GHz band.<sup>36</sup> There are also several GSO FSS earth stations in this band.<sup>37</sup> These stations are limited to international systems under non-Government footnote NG104 of the Table of Frequency Allocations. Further, this band is also used for telemetry, tracking, and command ("TT&C") functions for GSO satellites.<sup>38</sup> This band is important to existing GSO FSS and fixed service systems. Consequently, NGSO FSS gateway downlink operations must be carefully

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<sup>33</sup> See 47 C.F.R. §2.106, n. NG104.

<sup>34</sup> The GSO FSS operations in the 10.7-10.95 GHz and 11.2-11.45 GHz bands must adhere to the requirements specified in Appendix 30B of the ITU Radio Regulations and are referred to as "planned band" operations. GSO FSS operations are typically less extensively deployed in the Appendix 30B planned bands, as compared to non-planned bands. See No. S5.441 and Appendix 30B of the ITU-R Radio Regulations Provisions and Associated Plan for the Fixed-Satellite Service in the Frequency Bands 4500-4800 MHz, 6725-7025 MHz, 10.70-10.95 GHz, 11.20-11.45 GHz and 12.75-13.25 GHz. Use of these frequency bands is also governed by Resolution 130 (WRC-97).

<sup>35</sup> See Burlington Northern and Santa Fe Railway Company and Norfolk Southern Corporation Application Reply Comments at 3-4.

<sup>36</sup> See *Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum at 2 GHz for Use by the Mobile Satellite Service*, ET Docket No. 92-9, *Second Report and Order*, 8 FCC Rcd 6495 (1993) ("Emerging Technology proceeding"). See also, *First Report and Order & Further Notice of Proposed Rulemaking*, ET Docket No. 95-18, 12 FCC Rcd 7388 (1997) ("2 GHz MSS allocation proceeding").

<sup>37</sup> Our analysis indicates that there are approximately 113 authorizations issued for GSO FSS earth stations in the 10.7-11.7 GHz band. These authorizations do not indicate the actual number of earth stations or antennas that a licensee might deploy.

<sup>38</sup> The GSO FSS operations in this band perform TT&C communications to provide data on the spacecraft's functions via a two-way telemetry link between the satellite and the controlling earth station. TT&C communications are used throughout the satellite's life, including the launch and deployment phase. The TT&C function allows the earth station to control both the physical orbital position and internal functioning of the spacecraft.

considered to determine their impact on these incumbent operations.

17. We believe that NGSO FSS gateway downlink operations can share the 10.7-11.7 GHz band with incumbent fixed service and GSO FSS operations provided the gateway stations are not extensively deployed and proper coordination is performed. GSO FSS earth stations currently share this spectrum with fixed operations. We find that NGSO FSS gateway stations should also be able to share the spectrum subject to proper sharing criteria, as discussed below. Therefore, we propose to permit NGSO FSS gateway downlink operations in the 10.7-11.7 GHz band. To permit such operations, we propose to amend footnote NG104 to permit domestic NGSO FSS systems to operate in this band. We propose to maintain the international systems only requirement for GSO FSS systems to control the number of satellite earth stations deployed in the band. Alternatively, we invite comment as to whether we might permit domestic GSO FSS gateway operations in the U.S. subject to the qualifications proposed in this proceeding.

18. *Protection of fixed services (pfd limits).* In the proposed NGSO FSS gateway downlink band (10.7-11.7 GHz), NGSO satellites transmitting signals earthward may cause interference to terrestrial fixed receivers. SkyBridge argues that such interference can be controlled by requiring the satellite transmissions to meet the long term pfd limits which were adopted at WRC-97 to apply to NGSO FSS operations in this spectrum.<sup>39</sup> SkyBridge indicates that since the elevation angle of a fixed service station is generally less than a few degrees and NGSO satellite beams typically would not be directed at such low elevation angles towards the Earth, mainbeam-to-mainbeam interference from NGSO satellite transmitters should not occur. SkyBridge claims that there would be a low probability of an NGSO satellite at a low elevation angle passing through the mainbeam of a fixed service receiver pointed towards the horizon, i.e., 0.001% of the time.<sup>40</sup> Further, SkyBridge argues that the NGSO satellite's antenna gain decreases rapidly at elevation angles less than 10 degrees so that the magnitude of the interfering signals would be small.

19. Fixed service interests question SkyBridge's NGSO spectrum sharing analysis, arguing that SkyBridge has failed to demonstrate that its system would not interfere with fixed services. The Telecommunications Industry Association ("TIA") asserts that the pfd levels adopted at WRC-97 need further study and will be revisited at WRC-2000. TIA argues that the WRC-97 pfd limits intended to protect fixed receivers from satellite downlink transmissions could not be verified at recent ITU-R meetings and therefore asserts that SkyBridge has no basis to state

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<sup>39</sup> See Recommendation ITU-R F-758-1, *Considerations in the Development of criteria for sharing between the Terrestrial Fixed Service and Other Services*. This Recommendation sets an interference criteria for protection of terrestrial stations based on an interference-to-noise ratio of -10 dB for 20% of the time. This recommendation does not contain short term criteria.

<sup>40</sup> See SkyBridge Amendment at Appendix C at 16. It should be noted that fixed service receivers typically point towards the horizon. Hence, each station could experience this short term interference.

that the proposed NGSO operations would have no effect on fixed links.<sup>41</sup> Additionally, TIA states that any short term interference caused by an NGSO satellite transmitting into the mainbeam of a fixed service receiver could impair critical public safety and public utility fixed services and would be unacceptable.<sup>42</sup>

20. We propose to adopt the NGSO pfd limits adopted at WRC-97 because they have generally proven reliable for sharing between GSO FSS and fixed services. We recognize, however, that there are important differences between GSO FSS and NGSO FSS systems. In GSO FSS systems, the satellites remain at a fixed position relative to terrestrial fixed receivers, and therefore the antenna alignments and interfering signal levels remain constant. In NGSO FSS systems, the satellites are in constant motion relative to the terrestrial fixed receivers, and therefore the antenna alignments and interfering signal levels are constantly changing and have different statistical interference characteristics. Given these differences, we invite comment as to whether the pfd limits being proposed for long term interference protection are adequate to protect terrestrial fixed operations against interference from NGSO FSS operations. We note that Resolution 131 (WRC-97) recognizes "that further studies are required of the power flux-density limits applicable to non-GSO FSS systems for the protection of terrestrial services in the bands 10.7-12.75 GHz...", and that ITU-R Study Group 9 is actively studying the need for short-term interference criteria in this band. We invite comment on the work done to date on this issue in the ITU-R and on whether specific short-term limits are necessary. We note that some terrestrial fixed links operate over mountains, where the mainbeam of the fixed receiver antenna is pointed well above the horizon. It appears that mainbeam to mainbeam interference could occur under such circumstances. Parties advocating short term limits should provide specific recommendations supported by a thorough technical analysis.

21. *Coordination with fixed service stations.* Protection of NGSO FSS gateway receivers in the downlink (10.7-11.7 GHz) band from terrestrial transmitters would be accomplished through coordination. In the coordination process, new facilities from either service are responsible for determining the location of existing operations within a specified coordination distance and may use various factors, such as antenna directionality, terrain shielding, radio frequency ("RF") shielding, or frequency or geographic separation to ensure that new operations can be accommodated.

22. We propose to apply the existing prior coordination procedures used for GSO earth

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<sup>41</sup> See TIA Application Reply at 13. We note that these comments were submitted prior to the July 1998 JTG 4-9-11 meeting and October 1998 4-9S meetings where significant progress was made.

<sup>42</sup> While public safety mobile applications often operate on spectrum set aside specifically for that purpose, many state and local governments must use the standard fixed point-to-point spectrum in the Ku-band to establish fixed links between facilities or as backbone for their mobile networks which could be used by local police, fire and rescue.

stations and terrestrial stations as prescribed in Parts 25 and 101 of the Commission's rules.<sup>43</sup> We note that ITU recommendations for coordination areas generally specify smaller coordination areas for NGSO systems as opposed to GSO systems.<sup>44</sup> This is because interference occurrences between NGSO gateway stations and terrestrial stations would have a time-varying nature, as opposed to the constant interference signal level within the mainbeam of a GSO FSS earth station. Nevertheless, we continue to believe that the present coordination procedures are adequate to ensure that existing fixed operations are fully protected. We request comment on this approach. After we gain experience with NGSO FSS systems sharing with fixed operations, we may modify our coordination procedures to shorter distances as a result of the time-varying nature of the tracking of the NGSO FSS earth station.

23. *Gateway siting restrictions.* The 10.7-11.7 GHz band was identified for future use by fixed operations that must be relocated from the 2 GHz frequency band.<sup>45</sup> Thus, fixed operators need a reasonable assurance that coordination with NGSO FSS gateway stations would not hinder fixed service deployment. In order to maintain the opportunity for relocation and growth of fixed operations to the 10.7-11.7 GHz band, we propose to establish exclusion areas around the most populated cities<sup>46</sup> of the U.S., in which NGSO FSS gateway earth stations could not be located. We note that the nature of the proposed NGSO FSS gateway operations generally permits them to be located away from heavily populated areas where most fixed operations are deployed. The establishment of exclusion areas requires identifying how large each area should be and for which cities. We are mindful of the fact that too large an area or too many areas could preclude the implementation of NGSO FSS gateways in this band. However, we seek to balance the need to accommodate fixed service growth with the ability to accommodate the gateways of multiple NGSO FSS systems, thus allowing for NGSO FSS operations in the U.S.

24. Specifically, we propose to establish exclusion areas around the 50 most populated

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<sup>43</sup> See, e.g., 47 C.F.R. §§ 25.130, 101.103. We require prior coordination for licensing of FSS earth stations and terrestrial fixed stations. Under these procedures, the earth station applicant must, before filing an application with the Commission, identify all potentially affected licensees in the vicinity of their proposed earth stations and resolve all potential interference problems with existing licensees in the band. In its application, the applicant must certify that coordination has been achieved with affected licensees. The Commission places the applications on public notice, and existing licensees may file a petition to deny if coordination has not been completed. The earth station license would not be granted until all interference issues are resolved. Similar procedures are followed when a terrestrial station application is filed in shared frequency bands.

<sup>44</sup> See ITU-R Recommendation ITU-R IS.849-1, *Determination of the Coordination Area for Earth Stations Operating with Non-Geostationary Spacecraft in Bands Shared with Terrestrial Services*.

<sup>45</sup> See *supra* ¶ 16.

<sup>46</sup> These heavily populated areas are defined as the top populated cities in the U.S. as of April 1, 1990, as defined in the 1990 census.



cities, as defined by the 1990 Census. Each exclusion area would consist of a 100 km<sup>47</sup> radius around the city center. Appendix B provides the coordinates for these cities and a visual representation of the proposed exclusion areas. We believe that the proposed exclusion areas provide a workable compromise to ensure fixed service growth and enable NGSO FSS gateway deployment. We request comment on the proposed exclusion areas and seek specific suggestions for implementing this proposal. Particularly, we request comment on the number of areas, which areas, and appropriate exclusion distances, supported by both operational requirements and technical justification. Further, commenters should address whether exclusion areas should be considered for non-urban areas where, for example, numerous fixed links exist and where it may be difficult to coordinate additional links under existing topographical conditions (e.g., several western states have numerous fixed links to convey information in mountainous regions where it may be difficult to run fiber optic cables).

25. The intent of the exclusion area is to provide deployed fixed operations an opportunity to move from the 2 GHz frequency band. We, therefore, propose that any exclusion area requirement have a sunset date. That is, we would require NGSO FSS gateway stations to avoid deployment in the designated areas for a specified number of years (e.g., 5 or 10 years) to permit fixed service relocation. After this date, new NGSO FSS gateway stations would be able to locate facilities within these areas and standard coordination procedures would apply. Further, since fixed service relocation and future deployment is a major justification of the exclusion area concept, we request comment on which bands should have exclusion areas and on an appropriate sunset date for the suggested band. We seek comment on this proposal.

26. *Protection of GSO FSS downlinks (epfd limits).* Some commenters support the concept of NGSO FSS sharing with GSO FSS operations,<sup>48</sup> but others assert that SkyBridge has not demonstrated that its proposal would avoid causing interference to GSO FSS operations.<sup>49</sup> The provisional epfd limits adopted at WRC-97 are intended to protect GSO FSS operations against interference from NGSO operations. The Region 2 (which includes the U.S.) epfd limits include associated percentages of time during which the levels are not to be exceeded for specific GSO FSS receiver reference antenna diameter and patterns as depicted in Table 1. We believe, based primarily on studies carried out within the ITU-R, that the epfd levels needed to protect GSO FSS operations will not vary greatly from the WRC-97 provisional limits. If no acceptable alternative is developed, we believe these provisional limits will be adopted as the international sharing criteria at WRC-2000. Considering this, and that there is no alternative before us at this

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<sup>47</sup> See Appendix C for a map of 100 km radius circles around the 50 most populated cities with incumbent fixed operations.

<sup>48</sup> See, e.g., Comments of Teledesic Corporation and Loral Space & Communications LTD. ("Loral").

<sup>49</sup> See, e.g., Comments of Hughes Communications, Inc. ("Hughes"), Opposition of PanAmSat Corporation. We note that these comments were filed prior to the completion of the technical work at WRC-97 and the further work of the JTG 4-9-11.

time, we seek comment on the provisional epfd limits contained in Table 1. Any proposed modifications to these epfd limits must be supported with sufficient technical justification. If the record developed in this proceeding demonstrates that these limits are not appropriate to protect GSO FSS operations, we will explore alternative limits.

Table 1  
EPFD Limits To Protect GSO FSS Systems<sup>50</sup>

Frequency Band (GHz)	Equivalent pfd dB (W/m <sup>2</sup> ) <sub>(epfd)</sub>	Percentage of time during which equivalent pfd level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern
10.7-12.2	-179	99.7	4	60 cm, Rec. ITU-R S.465-5
	-192	99.9	4	3 m, Rec. ITU-R S.465-5
	-186	99.97	4	3 m, Rec. ITU-R S.465-5
	-195	99.97	4	10 m, Rec. ITU-R S.465-5
	-170	99.999	4	60 cm, Rec. ITU-R S.465-5
	-173	99.999	4	3 m, Rec. ITU-R S.465-5
	-178	99.999	4	10 m, Rec. ITU-R S.465-5
	-170	100	4	≥60c m, Rec. ITU-R S.465-5

27. We note that not all GSO antenna sizes are addressed in Table 1, such as GSO FSS receiver antennas greater than 10 meters in diameter.<sup>51</sup> We believe that any NGSO FSS system would have to protect all existing GSO FSS receivers from unacceptable interference and that coordination rather than epfd limits would be required to protect GSO FSS networks with large earth station antennas. Therefore, we request comment on the appropriate coordination procedures to be used for GSO FSS operations with large earth station antennas and what sized antennas should qualify for any special coordination procedures (e.g., 10 meters or greater). Additionally, protection also should be extended to GSO FSS earth stations receiving signals from satellites in inclined orbit.<sup>52</sup> The satellite industry relies on slightly inclined GSO operations to

<sup>50</sup> See *Final Acts of WRC-97*, Article S22 and Resolution 130, Table 1, Part A.

<sup>51</sup> We note that GSO FSS large aperture earth stations may be more sensitive to interfering signals than other earth station antenna sizes. WRC-97 noted that there could be a spectrum sharing problem between NGSO FSS satellites and large aperture GSO FSS earth stations. Further, within JTG 4-9-11, the U.S. has stated that the proposed epfd limits may not be sufficient to protect large aperture GSO FSS earth station antennas and the technical analysis on this subject is ongoing.

<sup>52</sup> In order to preserve station-keeping fuel as a satellite nears its end of life, a satellite operator may stop maintaining station-keeping of the satellite in the north-south direction, thus allowing the satellite to drift at an angle of inclination from the GSO arc (i.e., operate in an inclined orbit). Station-keeping fuel is one of the main factors that limits a satellite's life. A satellite in an inclined orbit is able to drift within a pre-defined north and south boundary, for example, +/-5 degrees around its nominal orbit location. Non-inclined geostationary satellites are only able to drift by +/-0.05 degrees or less in the north/south planes.

extend the life of a GSO satellite and continue service to customers. Permitting GSO satellites to drift some degree of inclination in the north/south direction has no impact on other GSO satellites, which are separated in the east/west direction. However, protection of satellites with a large north/south inclination could hamper NGSO system capacity. Therefore, we propose to protect only those GSO FSS satellites that do not exceed a certain degree of inclination and request comment on what that inclination angle should be. We request comment on whether the epfd limits in Table 1 adequately protect all FSS earth stations. Further, we ask that commenters include adequate technical analysis to support their position.

28. We note that WRC-97 developed spectrum sharing criteria for NGSO operations based on the avoidance of "unacceptable" interference to incumbent services. The Commission's rules define "accepted" interference, rather than "acceptable" interference.<sup>53</sup> We believe, however, that the two terms are substantially the same. "Unacceptable" interference would be occurrences exceeding a defined "acceptable" level of interference. We also note that the term "acceptable" interference or "unacceptable" interference happens to be more commonly used for international satellite coordinations. In order to determine whether "unacceptable" interference is occurring between an NGSO FSS system and an incumbent user in the Ku-band, we propose that the Ku-band sharing criteria, including provisions necessary to take into account any exceptional cases, ultimately adopted for NGSO FSS operations in this proceeding constitute an acceptable level of interference under our rules. Consequently, NGSO operations in the Ku-band that exceed such sharing criteria would constitute unacceptable interference to incumbent operations which must be avoided. We note that requiring NGSO FSS operations to avoid causing "unacceptable" interference is consistent with the terminology of S22.2 of the ITU Radio Regulations.<sup>54</sup> We request comment on this proposal.

29. *Protection of Telemetry, Tracking, and Command Links.* The JTG 4-9-11 has been analyzing how NGSO FSS systems would protect GSO TT&C during the launch (*i.e.*, transfer orbit) and operational (*i.e.*, on-station and the emergency operations) phases. With respect to protection of GSO transfer orbit operations, the impact of NGSO FSS would be infrequent and of short duration. These events can be planned to avoid interference. Due to the critical nature of transfer orbit operations, we propose that GSO (FSS and BSS) and NGSO FSS licensees consult with each other to ensure a successful deployment of the GSO spacecraft. We ask for comment on this proposal.

30. The contributions to the JTG 4-9-11 on the effects of the provisional epfd limits on the operational phase telemetry links are mixed. Although some contributions state that the effects would be insignificant, one contribution states that it would be possible for some telemetry

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<sup>53</sup> See 47 C.F.R. § 2.1. Accepted interference is "[i]nterference at a higher level than defined as permissible interference and which has been agreed upon between two or more administrations without prejudice to other administrations."

<sup>54</sup> See *Final Acts of WRC-97* at S22.2.

downlinks to be degraded below the required link threshold. Although the probability of such occurrences would be low, such an event could have significant and possibly catastrophic impact on TT&C operations. Given the potential seriousness of such occurrences, we seek comment on the adequacy of the provisional epfd limits on the telemetry downlink operations.

31. On rare occasions due to satellite or launch malfunctions, communications between the ground control station and a GSO satellite become severely impaired. During these emergency situations, the measures required to reacquire communications and regain control of the GSO satellite cannot be predetermined. We believe that it is necessary to protect GSO operations from NGSO interference in these situations and request comment on how this can be accomplished. Similarly, communications with NGSO satellites can become impaired and we seek comment on how to protect GSO operations from malfunctioning NGSO satellites.

## 2. NGSO Gateway Uplink Bands.

### a. 12.75-13.25 GHz band

32. *Current allocations.* The 12.75-13.25 GHz band requested for NGSO FSS gateway uplinks is allocated on a co-primary basis to fixed, FSS uplink, and mobile operations. This band is primarily used by Part 74 broadcast auxiliary service ("BAS") and cable television relay ("CARS") operations and Part 101 fixed microwave operations. Television stations use the fixed allocation for BAS studio-transmitter links and the mobile allocation for electronic news gathering ("ENG"). CARS licensees use this band to send video signals between points in their networks. Part 101 licensees use it for various point-to-point microwave links. According to our license data base, the 12.7-13.25 GHz band has more than 105,000 terrestrial operations. GSO FSS operations in this band must meet the requirements of the ITU Appendix 30B plan and Part 2 limits these operations to international systems.<sup>55</sup> Similar to the 10.7-11.7 GHz band, the international system only requirement for GSO FSS uplink operations has limited the number of GSO FSS earth stations in this band.<sup>56</sup> Further, the band may also be used for vital TT&C functions for the GSO FSS satellites.

33. While the terrestrial deployment in this band is extensive, we believe that NGSO FSS gateway stations (uplink) should be able to coordinate into some areas without interference problems with incumbent operations. Due to the level of incumbent service deployment, a large number of NGSO earth stations would not be possible in this band. We, therefore, propose to

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<sup>55</sup> See ITU Radio Regulations, Appendix 30B and 47 C.F.R. § 2.106 n. NG104. We note that there is one licensee using the U.S. Appendix 30B assignment in this band for domestic feeder links for a GSO MSS system.

<sup>56</sup> Our database indicates that there are 9 authorizations issued for GSO FSS earth stations in the 12.75-13.25 GHz band. These authorizations do not indicate the actual number of earth stations or antennas that a licensee might deploy. Additionally, this number may not include several international earth station authorizations issued before 1995 when the IBFS database was created.

limit NGSO uplink operations in the 12.75-13.25 GHz band to gateway type uplink operations subject to the coordination and the sharing criteria discussed below. Further, we propose to amend footnote NG104 of the Table of Frequency Allocations to permit domestic NGSO FSS systems to operate in the 12.75-13.25 GHz band. We propose to maintain the international systems only requirement for GSO FSS systems to control the number of satellite earth stations deployed in the band. Alternatively, we invite comment as to whether we might permit domestic GSO gateway operations in the U.S. subject to the qualifications proposed in this proceeding.

34. *Sharing with fixed and mobile services.* NGSO uplink transmitters have the potential to cause interference to terrestrial fixed and mobile receivers. We propose to facilitate sharing with fixed services by requiring coordination, as discussed above for the 10.7-11.7 GHz band. We invite comment on this proposal. We note that the 12.75-13.25 GHz band already includes over 3 times as many terrestrial operations as the 10.7-11.7 GHz band. Given the maturity of the use of this spectrum and that it is not specifically targeted for relocated fixed systems, we tentatively conclude that exclusion areas are not needed in the 12.75-13.25 GHz band.<sup>57</sup> We request comment on this conclusion. Further, we request comments as to what measures, if any, may be required to facilitate sharing with mobile services operating in this band.

35. *OpTel petition.* On April 1, 1998, OpTel, Inc. ("OpTel"), an operator of private cable systems, filed a petition for rulemaking with the Commission to amend Parts 78 and 101 of the Commission's rules to allow licensees in the fixed microwave service to use frequencies in the 12.7-13.25 GHz band to transmit video programming material to end users.<sup>58</sup> Specifically, OpTel proposes to amend Part 78 to make fixed licensees eligible for licenses in the CARS band and to amend Part 101 to allow fixed licensees to use the 12 GHz band for video programming. Additionally, the Commission has initiated a proceeding to consider the carriage of digital broadcast television signals over the cable TV infrastructure which may create capacity demands on the CARS frequencies. Both of these proceedings could greatly increase the terrestrial use of the 12.75-13.25 GHz band. Therefore, we request comment on whether these proceedings would conflict with potential NGSO FSS operations in the 12.75-13.25 GHz band.

36. *Sharing with GSO FSS uplinks (apfd limits).* WRC-97 adopted a provisional apfd limit of -170 dB(W/m<sup>2</sup>) to protect GSO FSS satellite receivers in the 12.75-13.25 GHz band from NGSO FSS earth station uplink interference.<sup>59</sup> This apfd limit may not be exceeded at any time. Similar to the epfd discussion above, we believe that any apfd limit adopted in this proceeding

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<sup>57</sup> We realize that existing deployment is no indication of future growth, but believe that bands with a high level of spectrum use may already require that NGSO FSS gateway be located in rural areas.

<sup>58</sup> See OpTel Petition for Rulemaking, RM-9257, filed April 1, 1998. On April 16, 1998, the Commission issued a Public Notice inviting comment on the OpTel petition and is currently reviewing the comments filed in response to the Public Notice. *Public Notice*, Report No. 2267, April 16, 1998.

<sup>59</sup> See *Final Acts of WRC-97*, Article S22 and Resolution 130, Table 2, Part A.

should protect all existing GSO FSS satellites, including uplink command TT&C communications. We believe, based primarily on studies carried out within the ITU-R, that the apfd limit needed to protect GSO FSS operations will not vary greatly from the WRC-97 provisional limit. If no acceptable alternative is developed, we believe this provisional limit will be adopted as the international sharing criteria at WRC-2000. Considering this, and that there is no alternative before us at this time, we seek comment on the provisional  $-170 \text{ dB(W/m}^2\text{)}$  apfd limit. Any proposed modifications to this apfd limit must be supported by sufficient technical justification. If the record developed in this proceeding demonstrates that this limit is not appropriate to protect GSO FSS operations, we will explore an alternative limit. Further, we ask for technical analysis to support the appropriate apfd limit to protect inclined orbit operations and for proposals regarding the appropriate level of inclination that merits protection.<sup>60</sup>

37. We also seek comment on whether the apfd definition should take into account GSO satellite receive antenna directivity. The definition of apfd contained in Article S22 adopted at WRC-97 did not take into account GSO satellite receive antenna directivity, but JTG 4-9-11 is now considering whether it should.<sup>61</sup> We believe that the definition of apfd overestimates the number of NGSO earth stations that would contribute to the apfd for GSO satellites with directive antennas.<sup>62</sup> If JTG 4-9-11 recommends a modification to the apfd definition and it were adopted at WRC-2000, the number of NGSO FSS earth stations that are taken into account when calculating the apfd from a NGSO FSS system would likely decrease. However, this change may not affect the apfd level itself, as that level is based on the required protection for the GSO FSS satellite. We seek comment on whether a new definition of apfd, taking into account the directivity of the GSO satellite antenna, would necessitate a corresponding change to the apfd levels. In addition, we request information on the appropriate satellite receive antenna reference pattern(s) that should be considered in developing a modified apfd definition.

b. 13.75-14.0 GHz band

38. *Current allocations.* The 13.75-14.0 GHz band requested for NGSO FSS gateway uplinks is allocated on a co-primary basis to Government radiolocation operations, such as high powered mobile radar systems. The band is also used on a co-primary basis by standard frequency and time satellite operations and space research/earth exploration-satellite operations, such as the National Aeronautical and Space Administration ("NASA") tracking data and relay

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<sup>60</sup> See *supra*, ¶ 27.

<sup>61</sup> To do so requires additional information on appropriate GSO satellite receive antenna reference patterns and beam widths.

<sup>62</sup> A directive antenna amplifies signals received from wanted directions and attenuates signals received from other directions. Thus, taking into account the directivity of a GSO satellite receive antenna would reduce the interfering contribution from NGSO FSS earth stations outside of the mainbeam (desired direction) of the GSO satellite antenna. This would reduce the number of NGSO earth stations that need to be taken into account.

satellite system ("TDRSS") and spaceborne sensors that provide weather and other significant data.<sup>63</sup> Further, the Commission recently allocated this band on a co-primary basis for FSS uplinks subject to certain sharing criteria.<sup>64</sup> The technical constraints on FSS are as follows: 1) the eirp of any emission from an earth station in the FSS shall be at least 68 dBW, and should not exceed 85 dBW, with a minimum antenna diameter of 4.5 meters;<sup>65</sup> and 2) the eirp density of emissions from any earth station in the FSS shall not exceed 71 dBW in any 6 megahertz band in the 13.772-13.778 GHz frequency range.<sup>66</sup> At this time, the FSS uplink use is relatively light due to the short time that the FSS has been allocated in the band and the prevalence of the Government operations. We have, however, licensed satellites to provide international operations in the band.<sup>67</sup>

39. As we discuss below, we propose to allow NGSO FSS operations in the 13.8-14.0 GHz portion of this band. However, we are not proposing to allow NGSO FSS operation in the 13.75-13.8 GHz band segment in order to protect NASA TDRSS operations. NGSO FSS gateway uplink operations should be able to share the 13.8-14.0 GHz band with incumbent Government and GSO FSS operations, subject to proper coordination and spectrum sharing criteria, as discussed below.

40. *Coordination with Government operations.* The 13.75-14.0 GHz band was allocated to the FSS in the *Report and Order* ("R&O") in ET Docket No. 96-20, released September 26, 1996.<sup>68</sup> In the R&O, the Commission stated that the 13.75-14.0 GHz band contained a number of important incumbent Government operations which must be protected.<sup>69</sup> To promote spectrum compatibility, the R&O adopted operating parameters for FSS operations

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<sup>63</sup> See 47 C.F.R. §2.106 n. S5.503, S5.503(a), and US337. NASA TDRSS operations are protected by footnote US337 of the U.S. Table of Allocations.

<sup>64</sup> See *Amendment of Parts 2, 25, and 90 of the Commission's Rules to Allocate the 13.75-14.0 GHz Band to the Fixed-Satellite Service, Report and Order*, ET Docket No. 96-20, 11 FCC Rcd 11951 (1996).

<sup>65</sup> See 47 C.F.R. §2.106 n. S5.502.

<sup>66</sup> See 47 C.F.R. §2.106 n. S5.502.

<sup>67</sup> See PanAmSat Licensee Corp., Application for Authority to Construct, Launch and Operate an Expansion Satellite in its Separate Communications Satellite System, 11 FCC Rcd 22098 (1996). Further, our database indicates that there are 13 authorizations issued for GSO FSS earth stations in the 13.75-14.0 GHz band. These authorizations do not indicate the actual number of earth stations or antennas that a licensee might deploy.

<sup>68</sup> See *supra*, n. 64.

<sup>69</sup> The band currently has several hundred relatively high-powered mobile radars operated by U.S. and other governments in this band worldwide; TDRSS, which is a critical national asset that provides communication links for U.S. space and satellite operations; and spaceborne sensors that provide weather and other significant data.

designed to facilitate sharing in the 13.75-14.0 GHz band.<sup>70</sup> SkyBridge contends that its gateways in the 13.75-14.0 GHz band would comply with the eirp and antenna restrictions of S5.502 of the ITU Radio Regulations.<sup>71</sup> However, the Office of the Assistant Secretary of Defense ("DoD") notes that the operating parameters adopted for GSO FSS operations in this band are based on ITU-R studies that did not consider NGSO operations. DoD contends that interference from Government radiolocation operations to NGSO FSS is probable.<sup>72</sup> The National Telecommunications and Information Administration ("NTIA") states that if NGSO operations are permitted to operate in the 13.75-14.0 GHz band, they must operate in accordance with the ET Docket No. 96-20 *R&O* and would have to accept interference from radiolocation stations.<sup>73</sup>

41. SkyBridge also claims that the interference power received by TDRSS spacecrafts in the 13.75-13.80 GHz range from SkyBridge gateways would be well below the noise floor of the TDRSS receiver.<sup>74</sup> However, NASA asserts that SkyBridge's analysis is incorrect because it assumed a TDRSS receiving antenna gain of -45 dBi rather than the actual value of -5 dBi. NASA asserts that even if SkyBridge's intended analysis used a 45 dB antenna isolation value from the mainbeam, the analysis would have resulted in an interference-to-noise density of 29.9 dB, an interference level NASA considers unacceptable for TDRSS operations.<sup>75</sup> More recently, NASA prepared and submitted a study to the July JTG 4-9-11 meeting that is more comprehensive than its previous analysis regarding sharing with NGSO FSS systems.<sup>76</sup> It should be noted that the NASA study was based on the original SkyBridge system and did not include recent modifications (e.g., from 64 to 80 satellites) and the technical information utilized indicated that SkyBridge was not operating in accordance with S5.502.

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<sup>70</sup> SkyBridge argues that it would comply with the requirements of S5.503A to protect space research and earth exploration-satellite services until the year 2000 because its system would not operate before the year 2001.

<sup>71</sup> Specifically, in this band, the eirp of any emission from an earth station in the fixed-satellite service shall be at least 68 dBW, and should not exceed 85 dBW, with a minimum antenna diameter of 4.5 meters. In addition, the eirp averaged over one second, radiated by a station in the radiolocation or radionavigation services toward the geostationary-satellite orbit shall not exceed 59 dBW. See ITU Radio Regulation at n. S5.502.

<sup>72</sup> See *supra* n. 32.

<sup>73</sup> *Id.*

<sup>74</sup> See SkyBridge Application at 18.

<sup>75</sup> See Letter from David Struba, NASA IRAC Representative, to Mr. William Hatch, IRAC Chairman, dated November 19, 1997, and placed in the record in this proceeding.

<sup>76</sup> See *Assessment of Potential Interference from SkyBridge Uplinks into Space-to-Space Links of the Space Research Service*, Document 4-9-11/130-E (June 24, 1998). This letter was submitted by SkyBridge into the file on its systems application and we are placing it into the docket for this proceeding.



42. To facilitate sharing with incumbent Government operations, we propose to apply the eirp and minimum antenna diameter limits for GSO FSS operations set forth in international footnotes S5.502 and S5.503 to new NGSO FSS operations in this band.<sup>77</sup> As noted in the *R&O*,<sup>78</sup> since the 13.8-14.0 GHz band is a shared Government/non-Government band, we propose to require coordination of all FSS earth stations located in the U.S.&P., including NGSO gateway stations, with Government radiolocation stations through the normal Frequency Assignment Subcommittee ("FAS") process of the Interdepartmental Radio Advisory Committee ("IRAC").<sup>79</sup> Further consideration will have to be given on how to facilitate sharing between the TDRSS forward link-to-LEO and earth stations not located in the U.S.&P. The *R&O* also adopted coordination requirements to permit new GSO FSS earth stations to share spectrum with NASA TDRSS operations.<sup>80</sup> In the coordination process, GSO FSS earth stations proposing to operate in this band would be coordinated with TDRSS earth stations and with the TDRSS forward link-to-LEO satellite in order to minimize harmful interference to their operations. Moreover, the FAS would apply the methods and criteria of Appendix 28 of the ITU Radio Regulations in order to protect the TDRSS earth stations. The *R&O* indicated that NASA converted the Appendix 28 requirements into a 390 kilometer (242.3 mile) coordination radius centered at 106.6° West Longitude and 32.5° North Latitude. We propose to use the same coordination process adopted in the *R&O* for NGSO FSS earth stations operating in this band and request comment on whether this coordination process is appropriate for NGSO earth stations. Considering DoD's statement that interference to NGSO FSS would be probable, we ask if these proposals would enable spectrum sharing in this band for NGSO FSS operations.

43. Nevertheless, we realize that coordinating and sharing spectrum with GSO operations can be different from sharing spectrum with NGSO operations. Particularly, we are concerned with NASA's argument that NGSO FSS uplinks would interfere with its TDRSS downlink to LEO (*i.e.*, shuttle) operations in the 13.75-13.80 GHz band. At this time, the record

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<sup>77</sup> See *R&O* at ¶ 18.

<sup>78</sup> See *R&O* at ¶ 19.

<sup>79</sup> The Commission submits non-Government frequency assignment applications for consideration by the FAS. If a conflict arises, the Commission will either request the applicant's assistance in its resolution or transfer the matter directly to the affected Government user(s) for resolution.

<sup>80</sup> We note that NASA currently has four geostationary space stations in the space research service operating space-to-space TDRSS links in the 13.75-13.80 GHz band and space-to-Earth links in the 13.80-14.05 GHz band. An additional TDRSS space station is planned. TDRSS satellites use the entire 13.75-14.0 GHz band as a downlink to communicate with two earth stations at the White Sands Complex in New Mexico: (1) the White Sands Ground Terminal is located at 106° 36' 31" West Longitude and 32° 29' 54" North Latitude; and (2) the Second TDRSS Ground Terminal is located at 106° 36' 48" West Longitude and 32° 32' 40" North Latitude. See *supra*, n. 32 at 11. Additionally, NASA has located an additional TDRSS earth station in Guam which would have to be considered in the frequency coordination process. See Letter from David P. Struba, NASA IRAC Representative, to Mr. William T. Hatch, Chairman of IRAC, dated November 10, 1998 and placed in the docket for this proceeding.

does not support permitting NGSO FSS operations in this 50 megahertz segment. Therefore, we do not propose to permit NGSO FSS systems to operate in the 13.75-13.80 GHz segment. However, if the JTG progress continues and sufficient technical analysis is submitted to demonstrate the feasibility of NGSO FSS sharing with NASA operations, we may permit NGSO FSS operations in this band segment. Nevertheless, we request comment on this proposal and further analysis on whether NGSO FSS operations would be able to share with the various Government operations in the entire 13.75-14.0 GHz band. Additionally, commenters should address whether any modifications to the proposed apfd limits would be necessary to protect Government operations in this band or whether different spectrum sharing criteria are needed to address these operations.

44. *Sharing with GSO FSS uplinks.* The issues discussed above regarding spectrum sharing between NGSO FSS gateway uplinks and GSO FSS uplinks (e.g., apfd limits, inclined orbit operations, TT&C, etc.) would also apply in the 13.8-14.0 GHz band. We, therefore, request comment and proposals on the appropriate technical requirements to enable NGSO FSS gateway uplink operations to share the 13.8-14.0 GHz band with GSO FSS operations and Government operations.

c. 14.4-14.5 GHz band

45. *Current allocations.* The 14.4-14.5 GHz band is allocated on a primary basis to FSS uplinks.<sup>81</sup> The primary use of this band is ubiquitously deployed GSO FSS uplink operations, including very small aperture terminal ("VSAT") operations.<sup>82</sup> This band is also allocated on a secondary basis for land mobile satellite uplinks, Government fixed and Government mobile operations. For example, the Federal Aviation Administration ("FAA") uses this band to transmit television microwave links that convey radar and video imagery between air facilities. Qualcomm uses this band for its Omnitrac system, a data service in the mobile satellite service providing tracking and data service to various entities such as the trucking industry.

46. *Sharing with GSO FSS uplinks.* We tentatively conclude that NGSO gateway uplink operations could share the 14.4-14.5 GHz band with the incumbent services provided an appropriate spectrum sharing criteria is adopted. The issues discussed above regarding spectrum sharing between NGSO FSS gateway uplinks and GSO FSS uplinks (e.g., apfd limits, inclined orbit operations, TT&C, etc.) also apply in the 14.4-14.5 GHz band. We, therefore, request comment and proposals on the appropriate technical requirements to enable NGSO FSS gateway

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<sup>81</sup> FSS uplinks generally operate over the entire 14.0-14.5 GHz band.

<sup>82</sup> Our database indicates that there are 2486 authorizations issued for GSO FSS earth stations in the 14.0-14.5 GHz band. The authorizations do not indicate the actual number of earth stations or antennas that a licensee might deploy. For example, since this is a VSAT band, a single GSO FSS authorization could cover several hundred or thousand VSAT antennas.

uplink operations to share the 14.4-14.5 GHz band with GSO FSS uplink operations. Additionally, Government use of this band appears light and should not present sharing problems with NGSO gateway operations, but we request comment on the impact of the proposed NGSO FSS operations on secondary uses of the band. Further, we request comment as to whether NGSO FSS user terminals could be accommodated in this band.

d. 17.3-17.8 GHz Band

47. *Current allocations.* The 17.3-17.8 GHz band is allocated on a primary basis to FSS uplinks, but US footnote US271 limits such operations in the U.S. to BSS<sup>83</sup> feeder link operations. BSS feeder links are used by various DBS licensees to support 12 GHz DBS downlinks.<sup>84</sup> Further, the 17.7-17.8 GHz portion is allocated on a primary basis to fixed operations,<sup>85</sup> mobile operations, and the FSS in the downlink direction. Additionally, the 17.3-17.7 GHz portion is allocated for secondary Government radiolocation operations. This band is also allocated internationally for BSS downlinks in Region 2, but this BSS allocation does not come into effect until April 1, 2007.<sup>86</sup> In September 1998, the Commission initiated a proceeding, in response to a petition received from DIRECTV, Inc. ("DIRECTV"), to implement this BSS allocation domestically.<sup>87</sup>

48. While SkyBridge argues that its gateway uplink operations could share this spectrum with the GSO FSS and terrestrial services, it contends that maintaining the proper coordination distance between BSS downlink operations and NGSO FSS gateway uplink operations would be impractical.<sup>88</sup> We tentatively conclude that spectrum sharing between ubiquitous BSS downlink to subscriber operations and NGSO FSS uplink operations, both service

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<sup>83</sup> BSS transmissions are downlinks to subscriber dishes that typically carry video programming. BSS feeder links are uplinks to BSS satellites and are performed in FSS allocations. Feeder links are used to send programming to the satellite for retransmission on BSS downlink frequencies.

<sup>84</sup> See 47 C.F.R. § 2.106 n. US271.

<sup>85</sup> The 17.7-17.8 GHz band has 665 terrestrial operations. We note that TIA asserts that over 40,000 fixed links are licensed in the 18 GHz band. See TIA Application Comments at 10. This fixed allocation is used primarily for broadcast auxiliary operations, common carrier links, cable TV, and private radio users for data communications.

<sup>86</sup> See ITU Radio Regulations n. RR868A/S5.517.

<sup>87</sup> See DIRECTV Petition for Rulemaking, RM-9118, filed June 5, 1997. This petition was incorporated into the proceeding *Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum Frequency Bands for Broadcast Satellite-Service Use*, Notice of Proposed Rulemaking, IB Docket No. 98-172, released September 18, 1998.

<sup>88</sup> See SkyBridge Comments on DIRECTV's Petition at A-9 and A-10.

and gateway links, would not be possible. Therefore, we do not propose to permit NGSO FSS operations in the 17.3-17.8 GHz band. Below we discuss this assessment and seek comment on NGSO FSS sharing with the incumbent radiolocation operations and with BSS. We note that the spectrum sharing principles between NGSO FSS uplink stations and fixed operations in the 17.7-17.8 GHz band would be the same as those discussed in Section A2 with respect to the 12.75-13.25 GHz band. Since we are not proposing to permit NGSO operations in the 17.3-17.8 GHz band, we will not reiterate fixed sharing issues in this section.

49. *BSS downlinks.* The sharing scenario in this section is called reverse band operation, as the NGSO FSS is transmitting in the uplink direction, while the BSS transmission is in the downlink direction. WRC-97 designated this band for further study and did not adopt pfd limits for the band because of sharing difficulties between transmitting NGSO FSS earth stations and ubiquitous BSS receivers.<sup>89</sup> The U.S. recently submitted a document to JTG 4-9-11 with a preliminary assessment on reverse band sharing between BSS downlinks and NGSO FSS uplinks in the 17.3-17.8 GHz frequency band in Region 2.<sup>90</sup> The document states that there would be potential sharing difficulties between NGSO FSS earth station transmitters (user terminal and gateways) and ubiquitous GSO BSS receive earth stations using the same frequency band. For example, the required coordination distances for co-existence between BSS receive earth stations and NGSO FSS user terminal uplinks were found to be about 678 km without shielding and about 68 km with shielding.<sup>91</sup> The required coordination distances for co-existence between BSS receive earth stations and NGSO FSS gateway uplinks were found to be 93.9 km without shielding and 9.4 km with shielding. The document notes that further studies are needed to more accurately assess the interference situations between NGSO FSS earth stations and BSS receive earth stations, including taking into account the statistical nature of the interference.

50. We believe that such coordination distances would prohibitively limit a ubiquitous service, particularly, as Skybridge points out,<sup>92</sup> one where the receive stations are not under the control of the service operator. We therefore tentatively conclude that NGSO FSS user terminals or gateway uplink operations would not be compatible with ubiquitously deployed BSS receive earth stations. We invite comment on this tentative conclusion. Therefore, we are not proposing to amend our rules to permit NGSO FSS operations in the 17.3-17.8 GHz band at this time.

51. *Radiolocation.* Regarding the Government radiolocation operations in the 17.3-17.7 GHz band, NTIA requests that the Commission not authorize any NGSO FSS operations in this band and states that they cannot agree with any changes or waiver to the existing Table of

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<sup>89</sup> See *Final Acts of WRC-97*, Resolution 538, Table 1 at n.1.

<sup>90</sup> See Document JTG 4-9-11/90, U.S. input to the July 1998 meeting of the JTG 4-9-11.

<sup>91</sup> An additional attenuation of 20 dB was assumed for shielding.

<sup>92</sup> See SkyBridge Comments on DIRECTV's Petition at A-11.

Frequency Allocations or to the Commission's rules that would enable NGSO FSS operations in this band.<sup>93</sup> We also note that in response to DIRECTV's 17 GHz Petition, the National Telecommunications and Information Administration ("NTIA") sent a letter to the FCC stating that this band would not be available for BSS operations until the year 2007 in order to protect the U.S. Government's considerable investment in existing operations in the band.<sup>94</sup> We note that these Government operations are currently able to share with GSO BSS feeder links because footnote US259 to the domestic Table of Allocations limits radiolocation stations to operating powers of less than 51 dBW. However, because this footnote was created when the only satellite use of this band in the U.S. was geostationary, radiolocation stations have limited their power in accordance with this footnote only in the direction of the GSO arc. Satellites in other orbits could receive higher levels of interference, as radiolocation systems will be radiating indiscriminately in directions outside of the plane of the GSO arc in a manner that is not able to be predetermined or constrained in order to fulfill the functions of the radiolocation operation. In fact, away from the GSO arc, these secondary radars operate at powers of up to 116 dBW,<sup>95</sup> 65 dBW higher than the power radiated at the GSO arc. Additionally, the DoD argues that sharing between Government radiolocation operations and NGSO FSS operations in this band does not appear to be feasible. DoD states that it anticipates continued operation of radiolocation stations in the 17.3-17.7 GHz band even after April 1, 2007, when the BSS is authorized to operate in Region 2. Therefore, NTIA and DoD do not agree with permitting NGSO FSS operations in this band. Since NGSO satellites would operate at much lower altitudes and would be subject to extremely high eirp radar transmissions, we believe that interference from these radiolocation operations could be severe. Therefore, we are not proposing to amend our rules to permit NGSO FSS operations in the 17.3-17.8 GHz band.

B. NGSO FSS Service Link Bands (11.7-12.7 GHz and 14.0-14.4 GHz Bands)

52. NGSO FSS service links are used for transmissions between user terminals and satellites for both downlink and uplink communications. Spectrum sharing with NGSO FSS service links raises issues different than those considered with gateway stations, since user terminals are more numerous and they are unlikely to be deployed at planned locations. As we discuss in detail below, we propose to allow NGSO FSS service downlink operations in the 11.7-12.2 GHz band, which is primarily used in the U.S. by the GSO FSS, and in the 12.2-12.7 GHz band, which is primarily used for DBS downlinks. Further, we propose to allow NGSO FSS service uplink operations in the 14.0-14.4 GHz band, which is used primarily by the GSO FSS. It appears that spectrum sharing in these bands is possible. We seek to determine whether the provisional sharing criteria adopted at WRC-97 are adequate to protect incumbent operations that

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<sup>93</sup> See *supra* n. 32.

<sup>94</sup> See Letter from Richard D. Parlow, then Associate Administrator, Office of Spectrum Management, NTIA to Regina Keeney, Chief, International Bureau, dated December 30, 1997.

<sup>95</sup> See Document JTG 4-9-11/85, U.S. input to the July 1998 meeting of the JTG 4-9-11.

use this spectrum in the U.S. and allow for their growth. Analysis of sharing issues continues in international fora, which, in conjunction with the record developed in response to this Notice, should provide the basis for use of these bands by the NGSO FSS. Additional technical issues affecting these proposals (e.g., multiple NGSO systems, antenna reference pattern requirements and others) are discussed in Section D below and should be taken into account when addressing issues in this section. Finally, we propose a domestic NGSO FSS allocation in the 12.2-12.7 GHz band. We ask for comment on these proposals.

1. NGSO Service Downlink Bands

a. 11.7-12.2 GHz band.

53. *Current allocations.* The 11.7-12.2 GHz portion is allocated in the U.S. on a primary basis for FSS downlinks and is heavily used by VSAT operations.<sup>96</sup> Mobile (except aeronautical mobile) operations are also permitted in this band on a secondary basis, but there are only a few mobile operations in this band.<sup>97</sup> We propose to permit NGSO FSS service downlink operations to share the 11.7-12.2 GHz band with incumbent GSO FSS downlinks subject to the spectrum sharing criteria discussed below.

54. *Sharing with GSO FSS downlink operations.* NGSO/GSO downlink sharing in the 11.7-12.2 GHz band raises issues similar to those discussed in Section A1 above for NGSO gateway downlink operations in the 10.7-11.7 GHz band where GSO FSS downlink operations also occur. The proposed NGSO service downlink operations in the 11.7-12.2 GHz band, however, would transmit to an unlimited number of user terminal receivers which could be located anywhere within the satellite footprint without knowledge of the precise location. Additionally, the NGSO user terminals would typically employ much smaller aperture antennas, than their NGSO gateway counterparts. We request the same information for NGSO FSS service downlink operations in the 11.7-12.2 GHz band as those in the 10.7-11.7 GHz band. Specifically, we seek comment on the adequacy of the WRC-97 epfd limits contained in Table 1 above for NGSO operations to protect incumbent GSO FSS operations in the 11.7-12.2 GHz band. Commenters should evaluate the WRC-97 sharing criteria for NGSO downlinks in the 11.7-12.2 GHz band vis-a-vis the specific incumbent uses here. We also request information and proposals regarding sharing with GSO FSS large aperture earth stations, inclined orbit satellites, and TT&C links. We refer commenters to Section A above for the explanation of these issues and specific questions raised. We also invite comment with regard to any secondary mobile operations in this spectrum and the impact on such operations.

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<sup>96</sup> Our database indicates that there are 1798 authorizations issued for GSO FSS earth stations in the 11.7-12.2 GHz band. The authorizations do not indicate the actual number of earth stations or antennas that a licensee might deploy. For example, since this is a VSAT band, a single GSO FSS authorization could cover several hundred or thousand VSAT antennas.

<sup>97</sup> Our database indicates that there are 68 terrestrial operations licensed in this band.

b. 12.2-12.7 GHz Band

55. *Current allocations.* The 12.2-12.7 GHz band is allocated to the BSS for the provision of DBS services and internationally to NGSO FSS in Region 2.<sup>98</sup> DBS provides television programming transmitted from GSO satellites and received by small subscriber earth station antennas (with diameters as small as 45 cm). With over 6 million subscribers in the U.S.,<sup>99</sup> DBS is the closest competitor to the cable television industry for the provision of multichannel video program distribution services. This band is also allocated to the fixed service domestically and is used by the point-to-point microwave service. However, point-to-point fixed systems licensed in this band after September 9, 1983 must operate on a non-interference basis with respect to the DBS service.<sup>100</sup> Further, as discussed in Section F of this Notice, Northpoint petitions the Commission to authorize its proposed service in this band which would provide retransmission of local television signals and provide one-way data services to DBS subscribers.

56. *Protection of BSS downlinks (epfd limits).* SkyBridge's proposed epfd limits to protect DBS operations in the 12.2-12.7 GHz band are based on the technical parameters for BSS systems specified in the original 1983 Region 2 BSS Plan.<sup>101</sup> The DBS operators in the U.S. currently use different system parameters than those specified in the original 1983 Region 2 BSS Plan,<sup>102</sup> such as lower downlink eirp levels, satellite beams shaped to the service area, digital emissions and 45 cm diameter receive earth station antennas. Recognizing these modified DBS systems with varying receiver characteristics, WRC-97 adopted provisional epfd values for various receive earth station antennas in use in all three Regions,<sup>103</sup> including a 45 cm diameter receive earth station antenna. Nevertheless, the DBS industry opposes the epfd limits proposed by SkyBridge and the WRC-97 limits arguing that these epfd limits are wholly inadequate to

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<sup>98</sup> See *Final Acts of WRC-97*, Article S5, n. S5.487A.

<sup>99</sup> See *Primestar Partners L.P. Application Reply* at 2.

<sup>100</sup> See 47 C.F.R. § 101.147(p).

<sup>101</sup> See SkyBridge Petition at 20. These numbers are the same as proposed by France to WRC-97 (ref. Doc. 62), and were based on criteria for GSO FSS to protect BSS contained in Annex 4 to Appendix 30. The original 1983 BSS Plan's technical characteristics include downlink eirps of approximately 62 dBW, elliptical beams, analog emissions and one meter diameter receive earth station antennas. See ITU Radio Regulations, Appendix 30/S30, Annex 5.

<sup>102</sup> Specifically, Article 4 of Appendix 30/S30 contains procedures to modify the BSS Plans to use different technical parameters.

<sup>103</sup> An epfd limit takes into account the gain of the receive earth station antenna. Thus, a reference antenna pattern and diameter must be specified for each epfd value.

protect BSS.<sup>104</sup> For instance, DIRECTV argues that WRC-97 epfd limits are not adequate to protect smaller DBS receiver antennas, which are not as selective as larger antennas.<sup>105</sup> Table S22-1 from the Final Acts of WRC-97 contains the epfd limits provisionally adopted by WRC-97 in the BSS bands and is depicted below:

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<sup>104</sup> See, e.g., DIRECTV, Hughes Communications, Inc, and Hughes Network Systems, Inc. Application Reply at 8; and United States Satellite Broadcasting Company, Inc. ("USSB") Application Reply at 6.

<sup>105</sup> For smaller dishes, the level of the long term limit is closer to that of the short term limit, which shows that the long term has a greater impact for smaller dishes.



TABLE S22-1

FREQUENCY BAND ALLOCATED TO THE BSS	ANTENNA DIAMETER (CM)	EQUIVALENT PFD LEVEL (DB(W/M2/4KHZ)) WHICH MAY NOT BE EXCEEDED DURING THE PERCENTAGE OF TIME SHOWN		REFERENCE ANTENNA RADIATION PATTERN
		99.7%	100%	
11.7 - 12.5 GHZ IN REGION 1, 11.7 - 12.2 GHZ AND 12.5 - 12.75 GHZ IN REGION 3	30 60 90	-172.3 -183.3 -186.8	-169.3 -170.3 -170.3	RECOMMENDATION ITU-R BO.1213 <sup>106</sup>
12.2 - 12.7 GHZ IN REGION 2	45 100 120 180	-174.3 -186.3 -187.9 -191.4	-165.3 -170.3 -170.3 -170.3	SECTION 3.7.2 OF ANNEX 5 OF APPENDIX 30 <sup>107</sup>
17.3 - 17.8 GHZ IN REGION 2	FOR FURTHER STUDY1)			
1)THE INTERFERENCE FROM NON-GSO FSS SYSTEMS INTO GSO BSS SYSTEMS OPERATING IN THE FREQUENCY BANDS 17.3 - 17.8 GHZ RELATES TO THE TWO FOLLOWING SHARING SITUATIONS: •NON-GSO FSS TRANSMIT EARTH STATION INTO GSO RECEIVE EARTH STATION; •GSO BSS TRANSMIT SPACE STATION INTO NON-GSO FSS RECEIVE SPACE STATIONS. BOTH SITUATIONS NEED TO BE STUDIED, IN PARTICULAR SINCE COEXISTENCE OF RECEIVE BSS EARTH STATIONS AND LARGE NUMBERS OF TRANSMIT NON-GSO FSS TERMINALS WOULD NOT BE FEASIBLE WITHIN THE SAME COUNTRY.				

57. In the comments, and in the on-going international work, various methodologies have been identified as possible ways to determine the appropriate epfd limit to protect DBS.<sup>108</sup>

<sup>106</sup> See Reference Receiving Earth Station Antenna Patterns for Planning Purposes to be used in the Revision of the WARC BS-77 Broadcasting-Satellite Service Plans for Regions 1 and 3, Recommendation ITU-R BO.1213. This is the reference antenna pattern for BSS receive earth station antennas used in the revision of the Regions 1 and 3 BSS Plan at WRC-97.

<sup>107</sup> This is the reference antenna pattern for a one meter BSS receive earth station that was used in devising the original Region 2 BSS Plan in 1983.

<sup>108</sup> See, e.g., DIRECTV Comments at 9-15, SkyBridge Opposition at 37-39, and DIRECTV Reply at 9-12; Output document from October 1998 JWP 10-11S meeting, Document 10-11S/TEMP/41.

We seek comment on what criteria should be used in determining the appropriate epfd limits. We request justification for any proposed criteria.

58. Additionally, we agree with commenters in this proceeding that NGSO FSS operations should not hinder the evolution of the DBS.<sup>109</sup> DBS licensees are considering variations in their service, such as provision of high definition television signals, provision of one-way data services through the DBS satellite, the use of smaller DBS receive antennas and other system modifications that could reduce DBS protection margins. While our rules and the ITU Radio Regulations permit DBS licensees the flexibility to modify their systems (*e.g.*, no restriction on receive antenna size or modulation technique), the epfd spectrum sharing concept ties a particular epfd value to a specific receive earth station antenna diameter and reference pattern.<sup>110</sup> Given that the WRC-97 provisional epfd limits apply to certain antenna sizes and reference patterns, JTG 4-9-11 is investigating appropriate means to translate the adopted epfd limits among various antenna sizes and/or antenna reference patterns.<sup>111</sup> Similarly, various DBS antennas with non-symmetrical receive patterns are being studied to determine their ability to reject interfering signals from directions other than the geostationary satellite orbital plane.<sup>112</sup> Specifically, off-set feed receive earth station antennas may have different discrimination characteristics in directions other than the plane of the geostationary satellite orbit. We request comment on the impact that the WRC-97 provisional epfd limits would have on the evolution of DBS operations and other ways to ensure flexibility and reliability for existing and future DBS operations.

59. We are not convinced, based on the record to date, that the provisional epfd limits adopted by WRC-97 are adequate to protect the 45 cm dishes that are used in the U.S., especially if multiple NGSO FSS systems are deployed in this band. However, we believe that, if no acceptable alternative is developed, these provisional limits will be adopted as the international sharing criteria at WRC-2000. Considering this, and that there is no alternative before us at this

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<sup>109</sup> See, *e.g.*, SkyBridge Petition at 16 and DIRECTV Comments at 5-6. For example, DIRECTV is exploring future modifications to its DBS operations such as DBS spacecraft at higher EIRP levels, with corresponding more bandwidth-efficient modulation and coding schemes, the use of smaller subscriber antennas, or reduction in customer outage time. WRC-97 supports this concept. See *Final Acts of WRC-97*, Resolution 538, specifically considering a) and requests ITU-R a).

<sup>110</sup> See DIRECTV Comments at 8.

<sup>111</sup> Because the effect of an interfering epfd signal to DBS operations would vary according to the size and characteristics of the DBS receiving antenna, a method to interpolate epfd values among various antennas would enable NGSO licensees to determine the epfd value for a particular DBS antenna. While it may be more difficult to translate between different reference patterns, it should be possible to develop an interpolation method between antenna sizes using the same pattern. See Output document from the July 1998 JTG 4-9-11 meeting, Document 4-9-11/TEMP 28-E.

<sup>112</sup> See Output document from the July 1998 JTG 4-9-11 meeting, Document 4-9-11/TEMP 28-E.

time, we seek comment on the provisional epfd limits contained in Table S22-1. Any proposed modifications to these epfd limits must be supported with sufficient technical justification. If the record developed in this proceeding demonstrates that these limits are not appropriate to protect DBS services, we will explore alternative limits.

60. In addition, ITU-R JTG 4-9-11 is addressing the need for an additional epfd specification point at another percentage of time, for example, an epfd value not to be exceeded for around 90% of the time.<sup>113</sup> We seek comment on this concept, and particularly, what additional percentage of time would be appropriate, as well as the corresponding epfd value and technical justification.

61. *Other DBS applications.* DIRECTV is providing DBS to antennas mounted on aircraft.<sup>114</sup> SkyBridge states that mobile reception of DBS should not be protected from other operations, as this band is not allocated to the mobile-satellite service or to the aeronautical mobile-satellite service.<sup>115</sup> We believe that this type of mobile operation is consistent with the allocation because the DBS definition in the Commission's rules<sup>116</sup> does not limit transmissions to fixed receive earth stations. Nevertheless, we request comment on whether this type of BSS operation is consistent with the Commission's rules and whether it is appropriate to protect this type of reception. If so, we also request comment on whether these operations could be protected and what epfd limits would be appropriate to protect aircraft mobile antennas.

62. DIRECTV contends that the SkyBridge proposal is devoid of evidence demonstrating that NGSO FSS operations would protect TT&C operations.<sup>117</sup> The questions highlighted in Section A regarding GSO TT&C operations are relevant for protection of GSO BSS TT&C operations, and we request comment on these matters. We propose that NGSO and GSO operators coordinate their transfer orbit operations, and that emergency TT&C operations be protected.

## 2. NGSO Service Uplink Bands

### a. 14.0-14.4 GHz band

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<sup>113</sup> *Id.*

<sup>114</sup> See DIRECTV Application Comments at 15. According to DIRECTV, these antennas tend to have wider beams in elevation than in azimuth, sometimes significantly wider.

<sup>115</sup> See SkyBridge Opposition at 47.

<sup>116</sup> See 47 C.F.R. § 100.3.

<sup>117</sup> See DIRECTV Application Comments at 13.

63. *Current allocations.* The 14.0-14.4 GHz band is allocated on a primary basis to FSS uplinks.<sup>118</sup> While there are several secondary allocations in this band, the primary usage is by ubiquitously deployed GSO FSS uplink operations, including very small aperture terminal ("VSAT") operations. Additionally, the 14.0-14.2 GHz segment is allocated on a secondary basis to Government radionavigation, non-Government radionavigation, and space research operations.<sup>119</sup> There are no significant radionavigation operations in the 14.0-14.2 GHz segment other than for small handheld radionavigation devices used along certain waterways under our Part 80 maritime rules. Additionally, this 14.2-14.4 GHz segment is allocated on a secondary basis to the mobile service, for such operations as television pickup links for Part 101 licensees.<sup>120</sup> Further, the entire 14.0-14.4 GHz band is available for secondary land mobile satellite uplink operations.

64. Because this band is primarily used for GSO satellite uplink operations, SkyBridge proposes to place NGSO FSS user terminals in this band. Similar to the incumbent GSO earth stations, the NGSO user terminals could be deployed anywhere. As discussed below, we believe sharing with GSO FSS operations in this band is feasible. Additionally, the secondary operations in the band should not suffer any greater impact than they would from existing GSO FSS uplinks. Therefore, we propose to permit NGSO service uplinks in the 14.0-14.4 GHz band, subject to the development of an appropriate sharing criteria, as discussed below.

65. *Sharing with GSO FSS uplinks.* The NGSO/GSO sharing scenario in the 14.0-14.4 GHz band raises issues similar to those discussed in Section A regarding NGSO gateway uplinks in the 12.75-13.25 GHz and 13.75-14.0 GHz bands. The proposed NGSO service uplink operations in the 14.0-14.4 GHz band, however, could entail an unlimited number of NGSO user terminal transmitters throughout the U.S.<sup>121</sup> Nevertheless, the issues regarding apfd limits, TT&C protection, GSO inclined orbit concerns and others discussed above still apply. We request the same information for NGSO FSS service uplink operations in the 14.0-14.4 GHz band as those in the 12.75-13.25 GHz band. We refer commenters to Section A above for the explanation of these issues and specific questions raised. Further, given that this band could contain a large number of NGSO user terminal uplink transmitters with much smaller aperture antennas, than their NGSO gateway counterparts, commenters should address whether the WRC-97 apfd level adequately protect GSO satellites from the aggregate power of an unlimited number of NGSO

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<sup>118</sup> Our database indicates that there are 2672 authorizations issued for GSO FSS earth stations in the 14.0-14.5 GHz band. The authorizations do not indicate the actual number of earth stations or antennas that a licensee might deploy. For example, since this is a VSAT band, a single GSO FSS authorization could cover several hundred or thousand VSAT antennas.

<sup>119</sup> See 47 C.F.R. §§ 2.106, 87.187(x).

<sup>120</sup> See 47 C.F.R. § 101.803(a).

<sup>121</sup> This is possible because there are no primary terrestrial operations in this band that would require coordination and GSO earth stations in this band are similarly deployed.

earth station transmitters.

66. Additionally, we note that SkyBridge requested that both NGSO service uplinks and gateway uplinks be permitted to operate in the 14.2-14.4 GHz segment. Because this band is able to accommodate a variety of GSO FSS operations, we propose to allow NGSO FSS operators the flexibility to implement NGSO FSS gateway uplink or users terminal uplink operations in the 14.2-14.4 GHz segment. The NGSO FSS gateway stations would have to meet the technical requirements for the band proposed in the previous paragraph. We do not see incompatibilities between the NGSO operations and incumbent services, but request comment on this proposal.

C. Accommodation of Multiple NGSO FSS Systems.

1. Spectrum Sharing Among Multiple NGSO FSS Systems

67. It is important to accommodate, if technically feasible, multiple NGSO FSS systems to promote greater competition in the satellite industry. Indeed, competing NGSO FSS applications have already been filed, but they propose systems that are significantly different from Skybridge's. Denali Telecom L.L.C. ("Denali") has applied for a license for a highly elliptical orbit ("HEO") FSS system, Pentriad, to operate in several bands, including the 11.7-12.2 GHz band.<sup>122</sup> Additionally, Boeing has filed for access to 109 megahertz of Ku-band spectrum for feeder links to serve its 2 GHz NGSO MSS ("MEO") system.<sup>123</sup> SkyBridge identifies two basic sharing scenarios for multiple NGSO FSS systems: (1) sharing between or among "homogeneous" NGSO FSS systems, and (2) sharing between or among "non-homogeneous" NGSO FSS systems. SkyBridge defines "homogeneous" NGSO FSS systems as those that have similar orbital characteristics and that share by interleaving their orbital planes.<sup>124</sup> SkyBridge defines "non-homogeneous" NGSO FSS systems as those having completely independent orbital characteristics. Skybridge asserts that, depending on a system's design, more than one "homogeneous" type NGSO FSS system should be able to share the same spectrum with a SkyBridge type system without causing harmful interference. Specifically, SkyBridge states that up to six SkyBridge-like systems can co-exist without harmful interference to each other.<sup>125</sup> SkyBridge also states that

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<sup>122</sup> See *Application of Denali Telecom LLC, Consolidated System Proposal for Authority to Launch and Operate Thirteen Satellites in the Pentriad System, an International Joint Venture Constellation of Thirteen Satellites Operating in Linked Molniya Highly-Elliptical Orbits in the International Fixed-Satellite Service and the Mobile Satellite Service*, filed September 26, 1997, 160-SAT-P/LA-97.

<sup>123</sup> See *Application for Authority to Construct, Launch and Operate a Non-Geosynchronous Satellite System in the 2 GHz Mobile Satellite Service and the Aeronautical Radionavigation-Satellite Service*. FCC File No. 179-SAT-P/LA-97 (September 26, 1997).

<sup>124</sup> See SkyBridge Opposition at 51.

<sup>125</sup> See SkyBridge Opposition at 52.

"non-homogeneous" NGSO FSS systems may not be able to use the same spectrum.

68. Systems with satellites in LEOs (such as SkyBridge), MEOs (such as Boeing) and HEOs (such as Pentriad) are considered "non-homogeneous" NGSO systems. Boeing and Denali assert that a SkyBridge-type, i.e., LEO, system should not be permitted to hinder other proposed NGSO FSS operations in these frequency bands. Similarly, Hughes, in its comments on SkyBridge's Petition, urges the Commission not to proceed with a proposal for NGSO use of the spectrum that effectively provides an entry opportunity for only one company.<sup>126</sup> In regards to sharing between NGSO FSS systems, Denali states that a SkyBridge-type system should have to implement mitigation techniques to protect HEO systems similar to those to protect the GSO arc. Boeing states that significant design changes (such as greatly increasing/decreasing satellite beam size or the number of satellites) to its or SkyBridge's system are necessary before they can share the same frequencies.<sup>127</sup> Boeing and Denali both suggest that it may be necessary to divide the frequencies between the various "non-homogeneous" NGSO systems.<sup>128</sup> In the case of sharing between "non-homogeneous" systems, mitigation techniques can often facilitate sharing (e.g., satellite diversity or high gain antennas).

69. At this time, we do not have sufficient information to determine exactly how many NGSO FSS systems, and in particular whether "non-homogeneous" type systems, would be able to operate in the Ku-band. Although we do not now propose any specific sharing principles or mitigation techniques to be used in coordination among multiple NGSO FSS systems, we ask for comment on what technical rules would facilitate sharing between NGSO FSS systems. For instance, we propose NGSO earth station antenna performance requirements in Section D and ask if other requirements should be required to facilitate NGSO/NGSO spectrum sharing. The Commission also recognizes that division of the spectrum, which would result in a reduction of each system's capacity, is also a feasible alternative if spectrum sharing proves to be unacceptable to any particular NGSO FSS system. We ask for comment on this alternative.

70. We also propose that all NGSO FSS systems be responsible for some portion of burden-sharing. Specifically, we expect all NGSO FSS applicants to bear some portion of the technical and operational constraints necessary to accommodate multiple NGSO FSS systems. In apportioning burden, we request comment on what factors are appropriate to consider. For example, how much importance should be placed on whether a particular NGSO FSS satellite is already in-orbit and operational in making such a determination? Further, we request comment on whether the potential NGSO FSS licensees that could be licensed as a result of an initial processing round should have any responsibility for accommodating subsequent NGSO FSS applicants.

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<sup>126</sup> See Hughes Comments at 2.

<sup>127</sup> See Boeing Application Comments at 5.

<sup>128</sup> See Denali Application Comments at 3, Boeing Application Reply at 6.

71. SkyBridge proposes that any future NGSO FSS system proposing to operate in the Ku-band should be required to operate on a non-interference basis with respect to any existing NGSO FSS systems operating in the subject bands.<sup>129</sup> The Commission typically opens filing windows for competing satellite applications to allow other interested parties an opportunity to participate in the licensing process. At the time we placed SkyBridge's application on Public Notice, we indicated that we would not establish a cut-off date for applications to be considered concurrently with SkyBridge's due to the outstanding issues raised by SkyBridge's proposal. Further, we stated that we would announce any cut-off date in a separate Public Notice and that we did not intend to grant SkyBridge's application without establishing a filing cut-off.<sup>130</sup> Therefore, by separate Public Notice, we have established a filing window for other NGSO FSS applications to be considered concurrently with the SkyBridge system.<sup>131</sup> All NGSO FSS applications for the Ku-band filed before the cut-off date will be considered on an equal basis. Additionally, we note that of the 3.2 gigahertz of spectrum (combined uplink and downlink) being considered for NGSO FSS operations in the Ku-band, SkyBridge requests access to 2.1 gigahertz for its system. Therefore, once all applications to be considered in this processing round are filed, we will have to determine which systems are compatible with one another and determine how to resolve situations of incompatibility.

## 2. Impact of Multiple NGSO FSS Systems On Sharing With Other Services.

72. The sharing criteria developed at WRC-97 are based upon a single NGSO FSS satellite or NGSO FSS satellite system. For example, the WRC-97 NGSO FSS pfd limits are identical to GSO FSS pfd limits for a single satellite.<sup>132</sup> We note that an ITU-R study group is attempting to develop a recommendation that would scale the NGSO FSS pfd limits relative to the number of satellites in an NGSO FSS system.<sup>133</sup> We note also that DIRECTV states that the impact of multiple NGSO FSS systems on sharing with DBS operations has not been sufficiently addressed.<sup>134</sup> We are concerned about the cumulative effect of multiple NGSO FSS systems on

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<sup>129</sup> See SkyBridge Petition at 17.

<sup>130</sup> See Public Notice, Report No. S.B.-98, August 28, 1997.

<sup>131</sup> See *Cut-off Established for Additional Applications and Letters of Intent in the 12.75-13.25 Ghz, 13.75-14.5 Ghz, 17.3-17.8 Ghz and 10.7-12.7 Ghz Frequency Bands*, Report No. SPB-141 (rel. November 2, 1998).

<sup>132</sup> See *Final Acts of WRC-97*, Resolution 131, Resolves 1.

<sup>133</sup> Specifically, Working Party 4-9S, the ITU-R group dealing with sharing between fixed services and FSS, is developing such a Recommendation. Further, commenters should be cognizant of the fact that not all visible LEO satellites belonging to a constellation illuminate (transmit to) the same geographical area and certainly not simultaneously from the mainbeam. The exact combination depends on the satellite accessing techniques (e.g. code division multiple access ("CDMA") and frequency division multiple access ("FDMA")).

<sup>134</sup> See DIRECTV Petition to Deny SkyBridge Application at 16.

the viability of sharing with other services. At the same time, we recognize that developing a method to predict the aggregate effect of all possible NGSO FSS systems in a given band may not be possible without knowing the technical characteristics of the specific NGSO FSS systems.

73. One way to protect incumbent systems from the effect of multiple NGSO systems is to make assumptions about the number of NGSO FSS systems that would operate in a frequency band and to make the appropriate adjustments to the WRC-97 levels based on these assumptions. If the number of "relevant" NGSO FSS systems is too large, there would be an added burden on each NGSO FSS system since the allowable short term time duration per NGSO FSS system would be too short. If the "relevant" number of NGSO FSS systems is found to be too low, then GSO FSS systems may not be protected from the additional impact of subsequent NGSO systems that were not included in the "relevant" number of NGSO FSS systems. Basically, the "relevant" number of NGSO FSS systems would determine how the total allowable unavailability time is divided into single entry short term time durations. We seek comments on the maximum number of NGSO FSS systems that are "relevant" for determining sharing criteria with other services.

74. We invite comment as to how the proposed sharing criteria should be applied or adjusted to account for multiple NGSO systems. For example, we could apply the requirement that an NGSO FSS systems should not cause more than 10% of the unavailability time in a GSO (FSS or BSS) network,<sup>135</sup> to the aggregate effect of all NGSO systems. Also, we could adjust the pfd limits used to protect fixed operations to provide some margin to allow for cumulative effects of multiple NGSO FSS systems. Any suggested adjustments to the sharing criteria to account for multiple systems should be supported by a technical justification. We also invite comment as to other means to facilitate spectrum sharing by multiple NGSO FSS systems with existing services. For example, we may need to establish a limit on the number of NGSO FSS systems that should be permitted to operate in this spectrum. Parties suggesting limits on the number of satellite systems should consider that such systems may be licensed internationally, as well as by the U.S. We solicit any other information or recommendations that may be appropriate to enable multiple NGSO systems to share spectrum with existing services without causing interference.

#### D. Other Technical Rules.

75. *GSO Arc Avoidance.* SkyBridge's system proposal states that its earth stations would not transmit to an NGSO satellite that is within + or - 10 degrees of the GSO arc as viewed from the GSO earth station. Additionally, SkyBridge plans to cease transmissions from its satellites when they are within + or - 10 degrees from the GSO arc, as viewed from the GSO

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<sup>135</sup> The unavailable time of a typical GSO FSS service link is related to the propagation phenomenon (e.g., rain) in the space-to-earth path.



earth station.<sup>136</sup> By avoiding in-line interference<sup>137</sup> with GSO FSS transmissions, SkyBridge claims that it would be able to reduce the signal levels that are received by GSO space and earth stations. Although this is one technique to facilitate sharing with GSO operations, the epfd and apfd sharing criteria we propose do not explicitly require the NGSO system to employ GSO arc avoidance. While the arc avoidance technique may be used by different NGSO FSS systems to share with GSO systems and could be a condition upon such Ku-band NGSO licensees, we do not propose to place such a requirement in our rules. We note that, through the use of a wider GSO arc avoidance angle, an NGSO system can also reduce the level of interference into the NGSO system from GSO satellites and earth stations. Additionally, any arc avoidance technique would be beneficial in the protection of GSO satellites in slightly inclined orbits.

76. *GSO earth station off-axis eirp density limits.* WRC-97 adopted, then subsequently suspended, GSO FSS earth station off-axis eirp density limits in the 12.75-13.25 GHz, 13.75-14.0 GHz and 14.0-14.5 GHz (uplink) bands.<sup>138</sup> Limiting the signal energy radiated by GSO FSS earth stations places an upper bound on the level of uplink interference that NGSO FSS systems must tolerate. The WRC-97 limits, contained in proposed rule Section 25.204(g), Appendix A, were taken from an ITU-R Recommendation on earth station off-axis eirp levels.<sup>139</sup> Working Party 4A ("WP4A") proposed modifications to this recommendation at its October 1998 meeting. The proposed changes limit the scope of the recommendation to GSO FSS earth stations and allow the levels to be exceeded for telecommand and ranging carriers transmitted to GSO FSS satellites.<sup>140</sup>

77. Since Part 25 of the Commission's rules already contains similar earth station

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<sup>136</sup> GSO satellites orbit the earth at a radius of 35,780 km lying in the plane of the equator. To an observer on the ground, the satellite in GSO appears to remain at the same position in the sky.

<sup>137</sup> In-line interference occurs when a NGSO satellite passes within the mainbeam of a GSO space or earth station. The GSO satellite, NGSO satellite and GSO earth station are in a straight line, or the GSO satellite, NGSO satellite and NGSO earth station are in a straight line.

<sup>138</sup> These limits, contained in Section VI of Article S22 and Resolution 130, were suspended by WRC-97 because many countries expressed concern over their ability to comply with the limits and decided that more time was needed to study their impact. The limits will be revisited at WRC-2000. It should be noted that these suspended limits apply to both GSO and NGSO earth stations.

<sup>139</sup> See ITU-R Recommendation S.524, Maximum Permissible Levels of Off-Axis EIRP Density from earth stations in the FSS transmitting in the 6 and 14 GHz was originated in Study Group 4 which deals with Fixed-Satellite Service issues. Working Party 4A is responsible for this recommendation.

<sup>140</sup> See *Preliminary Draft Modification to Recommendation ITU-R S.524 on Earth Station Off-Axis e.i.r.p. Density Levels*. Other changes were proposed outside of 12.75-14.5 GHz frequencies, 4A/TEMP/73 Rev.1.

reference antenna patterns and transmitter power limits,<sup>141</sup> we believe GSO FSS earth stations should have no problem meeting these limits. Thus, we propose to apply the off-axis eirp density levels contained in the modified ITU recommendation to GSO FSS earth stations in the 12.75-13.25 GHz, 13.8-14.0 GHz and 14.0-14.5 GHz bands. Consistent with the recommendation, these limits would apply in any direction within 3 degrees of the GSO arc. We ask for comment on the impact to the NGSO system of not requiring these limits to be met beyond  $\pm 3$  degrees of the GSO arc. Also, we seek general comments on this proposal that take into account the antenna performance standards of Part 25.209(a)(1) and (2).

78. *NGSO earth station antenna reference pattern.* SkyBridge has proposed to operate its user terminals with a more relaxed antenna reference pattern<sup>142</sup> than that required for FSS earth stations in Section 25.209 of our rules. Generally, the FCC recommends the use of higher performance earth station antennas to maximize sharing between systems and use of the frequency spectrum. We prefer to continue this policy for the new NGSO technology. As Ku-band NGSO FSS is a new technology, it should be possible to design earth station antennas to meet the antenna performance requirements in our rules. Accordingly, we propose to require NGSO FSS user terminal antennas to meet the antenna performance requirements of Section 25.209 of the our rules. As NGSO FSS earth stations will not be transmitting in the direction of the geostationary orbit, effectively only Section 25.209(a)(2) of the Commission's rules, or  $32-25 \log \theta$ , would apply to NGSO FSS user terminal antennas. This would facilitate sharing with GSO and other NGSO services, by providing greater protection to those services. We seek comment on this proposal. If there are objections to this proposal, we request justification as to why NGSO FSS systems cannot meet this requirement.

79. SkyBridge states that the antenna reference pattern of its gateway earth stations would comply with the antenna reference pattern of  $29 - 25 \log(\theta)$ .<sup>143</sup> This antenna reference pattern is better than that required by Section 25.209(a)(2) of the Commission's rules for earth stations operating in directions other than that of the GSO plane. Since we generally encourage the use of higher performance earth station antennas to maximize sharing between systems, we propose to apply this antenna requirement to NGSO FSS gateway antennas for all directions. This would facilitate sharing with other services by providing greater protection to those services and systems. We seek comment on this proposal. If there are objections to this proposal, we

<sup>141</sup> There are two components to the off-axis eirp density of an earth station--the earth station antenna performance in the sidelobe region and the RF transmitter power density. The sidelobe requirements limit the gain of the antenna in directions outside of the mainbeam (wanted direction) of the antenna. The RF transmitter power density limits the magnitude of the power radiated.

<sup>142</sup> Specifically, SkyBridge proposes to use an antenna gain pattern of  $36-25 \log(\theta)$  ( $100\lambda/D \leq \theta < 48^\circ$ );  $-6$  ( $\theta \geq 48^\circ$ ).

<sup>143</sup> See SkyBridge Opposition at 67. This antenna reference pattern is identical to that contained in Section 25.209(a)(1). See 47 C.F.R. § 25.209(a)(1).

request justification as to why NGSO FSS systems cannot meet this requirement and the specific requirements that can be met.

80. *Validation of pfd/epfd/apfd limits.* In this Notice, we seek comment on pfd/epfd/apfd limits proposed at WRC-97 to enable spectrum sharing between new NGSO FSS operations and incumbent operations in the Ku-band. We also must ensure that any NGSO FSS licensee meets such limits by creating processes for validating that a licensee can operate accordingly. Internationally, the JTG 4-9-11 is developing a specification for software for use by the ITU in determining if a NGSO FSS system meets the pfd, epfd and apfd limits to protect other services. Within the U.S., the Commission needs to verify that a proposed system meets the appropriate limits for domestic licensing purposes, as well as to confirm information that will be sent to the ITU. In addition, the U.S. communications industry should have sufficient information to validate that a proposed system meets the limits. We ask for comment on whether the U.S. should use a commonly accepted software tool, such as that being developed by JTG 4-9-11, to perform these analyses.

81. We propose that NGSO FSS applicants provide the Commission with sufficient information on the NGSO FSS system characteristics and software capability to properly model the system in computer sharing simulations. This information would include, at a minimum, NGSO hand-over and satellite switching strategies, NGSO satellite beam patterns, and NGSO earth station antenna patterns. In particular, each NGSO FSS applicant would explain the switching protocols it uses to avoid transmitting while passing through the geostationary satellite orbit arc. In addition, each applicant would provide the orbital parameters required to comply with the U.S. international obligations in accordance with ITU-R Resolution 46.<sup>144</sup> We ask for comment on whether it is necessary and feasible for the NGSO FSS operator to provide the suggested parameters and software. Alternatively, which NGSO FSS system parameters should be provided to verify compliance of the NGSO FSS system? If commenters suggest that any of these parameters should not be provided for any reason (e.g., switching protocols), they should explain how they propose that compliance be verified domestically and internationally and indicate which system characteristics would be needed for such an approach.

82. *Emission limits.* Radio astronomy operations have a primary allocation in the 10.6-10.7 GHz band. Footnote US211 urges space stations in the 10.7-11.7 GHz band to take all practical steps to protect radio astronomy operations.<sup>145</sup> We note that radio astronomy operations utilize some of the most sensitive instruments made and even unwanted emissions through zero dB sidelobes may completely destroy observations. The detrimental interference limit in the 10.68-10.7 GHz band from a terrestrial transmitter to radio astronomy receiver is -240 dBW/m<sup>2</sup>/Hz. The terrestrial transmitters are assumed to be seen through zero dB sidelobes, which are located about 19 degrees off axis of the main beam of the radio astronomy antenna. For GSO

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<sup>144</sup> See ITU Radio Regulations, Resolution No. 46, Annex 1, Section A.3 (WRC-95).

<sup>145</sup> See 47 C.F.R. § 2.106 n. US211.

satellite transmissions within 5 degrees of the main beam axis of the radio astronomy antenna, an extra 15 dB attenuation would be required. Therefore, NGSO satellite transmitters would have to be below -255 dBW/m<sup>2</sup>/Hz in the 10.68-10.7 GHz band.<sup>146</sup> In order to protect radio astronomy receivers, the aggregate power flux density from all NGSO satellites in a constellation would have to be below -255 dBW/m<sup>2</sup>/Hz. We request comment on how NGSO FSS satellite downlink transmissions would avoid causing harmful interference to sensitive radio astronomy operations. Specifically, since NGSO satellites can be anywhere in the sky and have the potential to transmit directly into radio astronomy receivers as they orbit over a certain area, commenters should address what additional emission standards, including filtering requirements, and operational measures need to be developed to protect radio astronomy operations. Commenters should address whether the existing emission and frequency tolerance requirements for FSS at section 25.202 of our rules are sufficient to protect other incumbent Ku-band operations. Particularly, we request comment in regards to ubiquitously deployed user terminals for subscriber use with uplink capabilities, because such operations could be deployed in close proximity to other services without any coordination.

83. *RF Bio-Hazard.* We note that Section 1.1307(b) of our rules requires that all systems authorized under Part 25 comply with our environmental evaluation requirements. Of particular concern in this proceeding are the ubiquitously deployed NGSO FSS subscriber terminals that could be installed by individual customers in areas where people could come in close contact with RF transmissions to the LEO satellites. We request comment on ways to ensure that these new NGSO FSS systems would comply with the RF safety guidelines in our rules. Since some of these terminals may be customer installed, commenters should address whether the satellite operator, service provider, or manufacturer should ensure that the radiation hazards provisions are being followed. We also ask for comment on whether we should require appropriate labelling on the terminals to satisfy the RF safety rules.

#### E. Licensing and Service Rules

84. *Coverage requirement.* In the interest of furthering the creation of a seamless global communications network, we often establish coverage area requirements for NGSO FSS systems to serve the domestic public interest.<sup>147</sup> Consequently, we propose to adopt the same coverage requirements that we currently apply to the "Big LEO" systems operating in the 1610-

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<sup>146</sup> See Recommendation ITU-R RA.769-1.

<sup>147</sup> See *Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Mobile Satellite Service in the 1610-1626/2483.5-2500 MHz Frequency Bands*, Notice of Proposed Rulemaking ("Big LEO NPRM"), ET Docket No. 92-28, 7 FCC Rcd 6414 at ¶ 23 (1992); *Report and Order* ("Big LEO Report and Order"), ET Docket No. 92-28, 9 FCC Rcd 536 at ¶ 21 (1994). See also *Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*, Third Report and Order ("28 GHz Third Report and Order"), CC Docket No. 92-297, 12 FCC Rcd 22310 at 34 (1997).

1626.5/2483.5-2500 MHz frequency bands and the NGSO systems in the 17.7-20.2 GHz and 27.5-30.0 GHz frequency bands.<sup>148</sup> Specifically, we propose to require that Ku-band NGSO systems be capable of serving locations as far north as 70 degrees latitude and as far south as 55 degrees latitude for at least 75% of every 24-hour period. We will also require that Ku-band NGSO systems be capable of providing FSS on a continuous basis throughout the fifty states, Puerto Rico, and the U.S. Virgin Islands. We request comment on these proposals.

85. *Financial qualifications.* Historically, the Commission has fashioned financial requirements for satellite services on the basis of entry opportunities in the particular service being licensed.<sup>149</sup> The policy underlying these actions is the importance of an efficient use of spectrum such that grant of an underfinanced applicant should not prevent another fully capitalized applicant from implementing its plans to provide service to the public. In cases where we can accommodate all pending applications and future entry is possible, we have not looked to current financial ability as a prerequisite to a license grant. In situations where the spectrum in question was crowded by potential applicants, we have invoked a strict financial qualifications standard. In the present situation, we do not yet know how many applicants there will be for use of the Ku-bands. We do, however, know that the Ku-bands are already congested by existing operators. Even if there were only to be one new applicant for this proceeding, grant of a license to an underfinanced applicant might preclude or limit expansion by existing operators of the services they provide to the public. Consequently, in keeping with existing Commission policy we propose to adopt the strict financial standard adopted for the "Big LEO" proceeding.<sup>150</sup> Specifically, we propose to require applicants to provide evidence of uncommitted current assets or irrevocably committed debt or equity financing sufficient to meet the estimated costs of constructing all planned satellites, launching them, and operating the system for the first year. We request comment on applying this proposal to NGSO FSS operations in the Ku-band.

86. *System license and license terms.* NGSO systems historically consist of constellations of technically identical satellites that may be launched and retired at different times. Consequently, existing NGSO licensee satellites in other bands have been licensed under blanket licenses.<sup>151</sup> Under this approach, licensees are issued a single blanket authorization for the construction, launch, and operation of a specified number of technically identical space stations. The authorization covers all construction and launches necessary to put the complete constellation into place and to maintain it until the end of the license term, including any replacement satellites necessitated by launch or operational failure, or by retirement of satellites prior to the end of the

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<sup>148</sup> See *Big LEO Report and Order* at ¶24; 47 C.F.R. §25.143(b)(2)(ii-iii); *28 GHz 3rd Report and Order* at ¶34.

<sup>149</sup> See 47 C.F.R. §§ 25.140(c), 25.142(a)(4), 25.143(b)(3).

<sup>150</sup> See *Big LEO NPRM* at ¶ 27.

<sup>151</sup> See *Big LEO Report and Order* at ¶¶ 182-187.

license period. All replacement satellites, however, must be technically identical to those in service and may not cause a net increase in the number of operating satellites. The license term runs from the date on which the first space station in the system begins transmissions and is valid for ten years from that time. There is a filing window for system replacement applications prior to the expiration of the license that allows sufficient time for the Commission to act upon replacement system applications. We believe it is appropriate to continue using this model of licensing and propose that replacement applications be filed no earlier than three months prior to and no later than one month after the end of the eighth year of the existing system license. We request comment on this proposal.

87. *Implementation milestones.* As with all other services, we propose that all NGSO FSS Ku-band licensees be required to adhere to a strict timetable for system implementation. This ensures that licensees are building their systems in a timely manner and that the orbit-spectrum resource is not being held by licensees unable or unwilling to proceed with their plans to the detriment of other operators who might benefit the public interest by implementing plans. We propose implementation schedules that track the schedules imposed on other NGSO FSS systems.<sup>152</sup> Specifically, we propose that NGSO FSS Ku-band licensees must begin construction of its first two satellites within one year of the grant of its authorization, and complete construction of those first two satellites within four years of grant. Construction of the remaining authorized operating satellites in the constellation would be required to begin within three years of the initial authorization, and the entire authorized system would have to be operational within six years. We request comment on this proposal.

88. *Reporting requirements.* We also propose to apply the Part 25 rules governing reporting requirements for FSS systems.<sup>153</sup> Specifically, licensees are required to file an annual report with the Commission describing: the status of satellite construction and anticipated launch dates, including any major delays or problems encountered; a listing of any unscheduled satellite outages for more than 30 minutes including the cause(s) of any such outages; and a detailed description of the utilization made of each satellite in orbit.<sup>154</sup> We request comment on this proposal.

89. *Exclusive arrangements in foreign countries.* The Commission can authorize operations of satellite systems in the U.S. only. Operation and use of these systems in geographic areas outside the U.S. requires appropriate authorizations from other countries in which the U.S. licensee wishes to operate earth stations. In other proceedings, in order to ensure that such service is truly global, we have adopted limitations on licensees' ability to enter into exclusive

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<sup>152</sup> See *Big Leo Report and Order* at ¶ 189; *28 GHz Third Report and Order* at ¶ 61.

<sup>153</sup> See generally *Streamlining the Commission's Rules and Regulations for Satellite Applications and Licensing Procedures, Report and Order* ("Part 25 Streamlining Order"), 11 FCC Rcd 21581 (1996).

<sup>154</sup> See 47 C.F.R. § 25.210(j)(1)(2)(3).

arrangements with other countries concerning communications to or from the U.S.<sup>155</sup> An exclusive arrangement generally would take the form of an agreement between a space station operator or service provider that establishes a particular satellite as the only permissible facility by which to offer a particular satellite service between the United States and the foreign country. An exclusive agreement may foreclose other FSS licensees from serving a foreign market, preventing that licensee from providing global service. We have construed the restrictions on exclusionary arrangements bearing in mind that spectrum coordination and availability in particular countries may limit the number of systems that can provide service to that country. Nevertheless, our intent has been to further the implementation and use of multiple satellite systems in other administrations. We propose to continue this policy in this proceeding and request comment on this proposal.

90. *Sale of license.* To discourage speculators and to prevent unjust enrichment of those who do not implement their proposed systems, we also propose a rule that prohibits any Ku-band NGSO licensee from selling a bare license for a profit. This provision is not intended to prevent the infusion of capital by either debt or equity financing. Nevertheless, any such transaction would be monitored to ensure that it does not constitute an evasion of the anti-trafficking provision.<sup>156</sup> We request comment on this proposal.

#### F. Northpoint Petition for Rulemaking

91. Northpoint has filed a Petition for Rulemaking to permit secondary terrestrial use of the 12.2-12.7 GHz band<sup>157</sup> by DBS licensees and their affiliates to allow retransmission of local television programming and provision of one-way broadband data to DBS receivers.<sup>158</sup> Northpoint would use northward pointing dishes at a DBS subscriber's location to receive signals transmitted from terrestrial towers with directional antennas pointing southward. Northpoint argues that because DBS earth stations are pointed southward to receive signals from GSO BSS satellites located over the equator, and Northpoint receive antennas would be pointed northward

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<sup>155</sup> See *Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz frequency band, Memorandum Opinion and Order*, 11 FCC Rcd 12861 at ¶¶ 54-55 (1996); 47 C.F.R. § 25.143(h) (prohibiting Big LEO licensees from entering into exclusive arrangements to serve particular countries); *28GHz Third Report and Order* at ¶ 74.

<sup>156</sup> See *Big Leo Report and Order* at ¶ 203; 47 C.F.R. § 25.143(h) (prohibits Big LEO licensees from selling a bare license for profit); *28 GHz Third Report and Order* at ¶ 75.

<sup>157</sup> While this band is already allocated to the fixed service, it is only designated for use by fixed point-to-point microwave systems. After September 9, 1983, these point-to-point systems had to operate on a non-interference basis with respect to DBS systems. See 47 C.F.R. § 101.47(p). Therefore, Northpoint proposes that its terrestrial operations would be secondary only to DBS operations.

<sup>158</sup> See Northpoint Petition at 1.

to receive signals transmitted from southward pointing Northpoint transmitting antennas, spectrum sharing with DBS would be possible. Northpoint acknowledges that there are areas close to the Northpoint transmitter where the Northpoint signal would be strong enough to interfere with DBS receivers,<sup>159</sup> but it contends that the impact can be minimized. Specifically, Northpoint contends that careful siting of its transmitters, increased tower height, attenuation in the vertical plane, and other techniques could be used to minimize the size of exclusion zones and lessen their effect on DBS subscribers.<sup>160</sup> While the DBS comments agree that the provision of local programming to DBS subscribers is beneficial, their comments oppose the Northpoint request arguing that the proposal would unacceptably interfere with DBS services.<sup>161</sup>

92. *Northpoint sharing with DBS.* Northpoint argues that providing local programming to supplement DBS will make DBS a true competitor to cable. However, the DBS commenters argue that they are already employing various solutions to bring local programming to their subscribers that would accomplish the same objective without causing any disruption to their service.<sup>162</sup> For example, they are engaged in improving over-the-air broadcast reception through the use of better terrestrial antennas and they are deploying additional satellite capacity to provide local programming. We seek comment on whether a Northpoint type service is desirable to satisfy DBS subscribers' local programming needs.

93. Echostar Communications Corporation ("Echostar") questions why Northpoint's technology requires the use of the 12.2-12.7 GHz band instead of bands the Commission has already set aside for ubiquitous or high density terrestrial services, including the Local Multipoint Distribution Service ("LMDS") in the Ka-band and spectrum in the 38 GHz band.<sup>163</sup> Northpoint argues that operating in the 12.2-12.7 GHz band would allow its service to be provided by making minimal changes to existing DBS equipment, thus making its provision less expensive. Specifically, Northpoint argues that a subscriber would use its existing DBS receiver with the addition of minimal equipment (*e.g.*, northward antenna, cabling, switch). We request comment

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<sup>159</sup> Northpoint refers to the area where DBS receivers could be adversely affected as a mitigation zone. However, the extent of interference to DBS receivers has yet to be quantified. While the term mitigation suggests that there might be some technique, such as manmade or terrestrial barrier fencing or other techniques that can lessen or mitigate the interference from Northpoint transmitters into DBS receivers, the absence of a requirement, or the feasibility for Northpoint type systems to use mitigation techniques might affectively turn these mitigation zones into exclusion zones where DBS service would not be available.

<sup>160</sup> See Northpoint's Reply at 6 and the attached Technical Annex at 10.

<sup>161</sup> See, *e.g.*, DIRECTV Opposition at 1, PRIMESTAR, Inc. ("PRIMESTAR") Opposition at 1, EchoStar Communications Corporation Opposition at 1, Tempo Satellite, Inc. ("Tempo") Comments at 1 and USSB Comments at 3.

<sup>162</sup> See PRIMESTAR Comments on Northpoint's Petition at 7.

<sup>163</sup> See EchoStar Comments on Northpoint's Petition at 2.



on whether existing equipment could be used, and if this would make Northpoint's service significantly less expensive than using other bands.

94. The DBS licensees have expressed doubt as to whether the Northpoint technology and DBS could share spectrum without creating harmful interference to DBS operations. DBS commenters state that Northpoint's experimental tests<sup>164</sup> and filings are inadequate to demonstrate that Northpoint can successfully share spectrum with DBS operations. Specifically, commenters indicate that Northpoint has not submitted sufficient analyses on reliable service areas, interference and the viability of mitigation zones. They question the reasonableness of Northpoint's service area if it is transmitting at a power low enough to protect GSO DBS reception. While Northpoint states it can provide a reliable service area of 10 miles,<sup>165</sup> Tempo disagrees.<sup>166</sup> Commenters also indicate that the feasibility of the use of power control to protect DBS during rain fade conditions is not adequately addressed, nor does Northpoint provide a description of how they will perform this task.<sup>167</sup> Moreover, further analysis is needed on the necessary carrier-to-interference ("C/I") ratio<sup>168</sup> to protect DBS from Northpoint transmissions and whether Northpoint's proposed system could meet these limits. DIRECTV states that any increase in the operational noise floor, such as that caused by Northpoint operations, would decrease DBS link availability and thus reduce the quality of DBS service and hinder future DBS innovation.<sup>169</sup>

95. While we recognize the potential benefits of the Northpoint proposal, the comments of the DBS licensees raise issues which require us to approach cautiously this type of operation in the DBS bands and seek further technical analyses on its ability to share the spectrum with DBS operations. For example, would Northpoint operations in the DBS bands cause harmful degradation of DBS to customers? Is the exclusion zone around each Northpoint

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<sup>164</sup> Northpoint has performed initial tests under an experimental license to determine the interference potential for the Northpoint system to DBS operations. Extensive questions were raised regarding the comprehensiveness and validity of Northpoint's first round of tests. Further, Northpoint is currently testing its proposed system under a second experimental license. Diversified Communication Engineering's application for modification of experimental license, which added Austin, TX, was granted on 7/20/98. The call sign is WA2XMY and the file number is 6001-EX-MR-1998.

<sup>165</sup> See Northpoint Petition at 19.

<sup>166</sup> See SkyBridge Comments at 1 and 6; Tempo Comments on Northpoint's Petition at 4-5.

<sup>167</sup> See DIRECTV Comments on Northpoint's Petition at 6; USSB Comments on Northpoint's Petition at 5-6; PRIMESTAR Comments on Northpoint's Petition at 3.

<sup>168</sup> The carrier-to-interference ratio provides a measure of the relative strength of the wanted signal ("C") to that of the interfering signal ("I").

<sup>169</sup> See DIRECTV Comments on Northpoint's Petition at 7.

transmitter small enough not to inhibit ubiquitous DBS service? Are the possible mitigation techniques and technical parameters suggested by Northpoint viable technical solutions to minimize the size of the exclusion zone, as well as facilitate DBS reception within this "zone"? Is Northpoint's technology designed with sufficient availability to be offered simultaneously with DBS to consumers? In addition, future analyses need to consider all DBS orbital positions that provide service to any geographic area throughout the U.S.<sup>170</sup> We believe it is important to address these and other technical issues prior to approving Northpoint operations in the 12.2-12.7 GHz band. We request comment and further analysis on spectrum sharing between DBS and Northpoint that address these concerns.

96. *Northpoint sharing with NGSO FSS.* In this Notice, we are proposing NGSO FSS operations in the Ku-band on a co-primary basis with incumbent services. We note, however, that in the 12.2-12.7 GHz bands, NGSO FSS and the proposed Northpoint technology may not be able to operate compatibly. Northpoint questions whether the provisional power limits adopted at WRC-97 would protect its system.<sup>171</sup> SkyBridge believes that these pfd limits would protect Northpoint, but asserts that Northpoint would cause interference to NGSO FSS.<sup>172</sup> There is no technical analysis in the record to support either party's assertion. Accordingly, we ask for comment regarding the feasibility of the two services sharing the same spectrum, such as, whether the WRC-97 pfd limits adopted to protect terrestrial services would be adequate to protect Northpoint's technology. We note that regardless of any action to allocate NGSO FSS to the 12.2-12.7 GHz band domestically, the ITU regulations could permit NGSO FSS satellites to transmit over the U.S. as long as they meet ITU limits. In addition, we request comment on what criteria would be necessary to protect NGSO FSS downlinks from interference from Northpoint.

97. If NGSO FSS and Northpoint type systems cannot share spectrum with each other in this band, but each service can share spectrum with DBS, we ask for comments on whether both NGSO FSS and Northpoint uses could be accommodated by other means. For example, would it be feasible to segment the DBS band to accommodate both new services sharing with DBS. We request comment and further analysis on this issue, including the amount of spectrum that each type of system would need and the ability to authorize multiple NGSO FSS or Northpoint systems, if we were to segment the band.

98. In conclusion, we believe that Northpoint has not provided sufficient information or analysis to demonstrate conclusively that its technology would not cause harmful interference to DBS. Accordingly, we find it premature to make any proposals based on Northpoint's petition

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<sup>170</sup> U.S. DBS orbital positions on the geostationary satellite orbit range from 61.5° W.L. to 175° W.L. DBS receive earth stations may be located within the continental U.S., Hawaii, Alaska, Puerto Rico and the U.S. Virgin Islands.

<sup>171</sup> See Northpoint's Petition at 18.

<sup>172</sup> See SkyBridge Comments on Northpoint's Petition at 23.

at this time. We request further information, as outlined in the preceding paragraphs, to allow us to develop a more comprehensive record regarding protection of DBS systems. In addition, we believe that our questions will allow us to compile technical analyses of the sharing potential of Northpoint and NGSO FSS.

#### IV. PROCEDURAL INFORMATION

99. *Initial Regulatory Flexibility Analysis.* The analysis pursuant to the Regulatory Flexibility Act of 1980, 5 U.S.C. Section 603, is contained in Appendix B.

100. *Ex Parte Presentation.* This is a permit-but-disclose rule making proceeding. Ex parte presentations are permitted, provided they are disclosed as provided in Commission Rules. See generally 47 C.F.R. Sections 1.1202, 1.1203, and 1.1206(a).

101. *Authority.* This action is taken pursuant to Sections 4(i), 7(a), 303(c), 303(f), 303(g), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 157(a), 303(c), 303(f), 303(g), and 303(r).

102. *Comment.* Pursuant to Sections 1.415 and 1.419 of the Commission's rules, 47 C.F.R. §§ 1.415, 1.419, interested parties may file comments on or before **February 16, 1999**, and reply comments on or before **March 15, 1999**. Comments may be filed using the Commission's Electronic Comment Filing System ("ECFS") or by paper copies. See Electronic Filing of Documents in Rulemaking Proceedings, 63 Fed. Reg. 24,121 (1998).

103. Comments filed through the ECFS can be sent as an electronic file via the Internet to <<http://www.fcc.gov/e-file/ecfs.html>>. Generally, only one copy of an electronic submission must be filed. If multiple docket or rulemaking numbers appear in the caption of this proceeding, however, commenters must transmit one electronic copy of the comments to each docket or rulemaking number referenced in the caption. In completing the transmittal screen, commenters should include their full name, Postal Service mailing address, and the applicable docket or rulemaking number. Parties may also submit an electronic comment by Internet e-mail. To get filing instructions for e-mail comments, commenters should send an e-mail to [ecfs@fcc.gov](mailto:ecfs@fcc.gov), and should include the following words in the body of the message, "get form <your e-mail address.>" A sample form and directions will be sent in reply.

104. Parties who choose to file by paper must file an original and four copies of each filing. If more than one docket or rulemaking number appear in the caption of this proceeding, commenters must submit two additional copies for each additional docket or rulemaking number. All filings must be sent to the Commission's Secretary, Magalie Roman Salas, Office of the Secretary, Federal Communications Commission, The Portals, 445 Twelfth Street, S.W., Room TW-A325, Washington, D.C. 20554.

105. Parties who choose to file by paper should also submit their comments on diskette.

These diskettes should be submitted to: Commission's Secretary, Magalie Roman Salas, Office of the Secretary, Federal Communications Commission, The Portals, 445 Twelfth Street, S.W., Room TW-A325, Washington, D.C. 20554. Such a submission should be on a 3.5 inch diskette formatted in an IBM compatible format using WordPerfect 5.1 for Windows or compatible software. The diskette should be accompanied by a cover letter and should be submitted in "read only" mode. The diskette should be clearly labelled with the commenter's name, ET Docket No. 98-206, type of pleading (comment or reply comment), date of submission, and the name of the electronic file on the diskette. The label should also include the following phrase "Disk Copy - Not an Original." Each diskette should contain only one party's pleading, preferably in a single electronic file. In addition, commenters must send diskette copies to the Commission's copy contractor, International Transcription Service, Inc., 1231 20th Street, N.W., Washington, D.C. 20037.

106. *Ordering clause.* IT IS ORDERED, that pursuant to Sections 4(i), 7(a), 303(c), 303(f), 303(g), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 157(a), 303(c), 303(f), 303(g), and 303(r), this Notice of Proposed Rulemaking is hereby ADOPTED.

107. IT IS FURTHER ORDERED that the Commission's Office of Public Affairs, Reference Operations Division, SHALL SEND a copy of this Notice of Proposed Rulemaking, including the Initial Regulatory Flexibility Analysis to the Chief, Counsel for Advocacy of the Small Business Administration.

108. *Additional Information.* For further information concerning this rule making proceeding contact Tom Derenge at (202) 418-2451, internet: tderenge@fcc.gov, Office of Engineering and Technology; Kim Baum at (202) 418-0756, internet: kbaum@fcc.gov, International Bureau; and Ed Jacobs at (202) 418-0624, internet: ejacobs@fcc.gov, Wireless Telecommunications Bureau, Federal Communications Commission, Washington, DC 20554.

#### FEDERAL COMMUNICATIONS COMMISSION

Magalie Roman Salas  
Secretary

**APPENDIX A:  
Proposed Rules**

Part 25 of title 47 of the Code of Federal Regulations is proposed to be amended as follows:

**PART 25-SATELLITE COMMUNICATIONS**

The authority citation for Part 25 continues to read as follows:

**AUTHORITY:** Secs. 25.101 to 25.601 issued under Sec. 4, 48 Stat. 1066, as amended; 47 U.S.C. 154. Interpret or apply secs. 101-104, 76 Stat. 419-427; 47 U.S.C. 701-744; 47 U.S.C. 554.

1. § 25.114 is amended by adding new paragraph (c)(xx) to read as follows:

§ 25.114 Applications for space station authorizations

\* \* \* \* \*

(xx) Applications for authorizations for non-geostationary satellite orbit systems in the fixed-satellite service in the frequency bands 10.7-11.7 GHz, 11.7-12.2 GHz, 12.2-12.7 GHz, 12.75-13.25 GHz, and 13.8-14.5 GHz shall also include the information specified in § 25.145(h).

2. Add new § 25.147 to read as follows:

§ 25.147 Licensing provisions for non-geostationary satellite orbit systems in the fixed-satellite service in the frequency bands 10.7-11.7 GHz, 11.7-12.2 GHz, 12.2-12.7 GHz, 12.75-13.25 GHz, and 13.8-14.5 GHz

(a) Unless stated otherwise, in general all rules contained in this Part apply to non-geostationary satellite orbit systems in the Fixed-Satellite Service in the frequency bands 10.7-11.7 GHz, 11.7-12.2 GHz, 12.2-12.7 GHz, 12.75-13.25 GHz, and 13.8-14.5 GHz.

(b) System License: Applicants authorized to construct and launch a system of technically identical non-geostationary satellite orbit satellites will be awarded a single "blanket" license covering a specified number of space stations to operate in a specified number of orbital planes.

(c) In addition to providing the information specified in § 25.114 above, each NGSO FSS applicant shall demonstrate the following:

- (1) That the proposed system be capable of providing fixed-satellite services to all locations as far north as 70 deg. latitude and as far south as 55 deg. latitude for

at least 75% of every 24-hour period; and

- (2) That the proposed system is capable of providing fixed-satellite services on a continuous basis throughout the fifty states, Puerto Rico and the U.S. Virgin Islands, U.S.
  - (3) Each applicant must submit sufficient information on the NGSO FSS system characteristics to properly model the system in computer sharing simulations [using the software under development within the ITU], including, at a minimum, NGSO hand-over and satellite switching strategies, NGSO satellite beam patterns, NGSO satellite antenna patterns and NGSO earth station antenna patterns. In particular, each NGSO FSS applicant must explain the switching protocols it uses to avoid transmitting while passing through the geostationary satellite orbit arc, or provide an explanation as to how the power-flux density limits in Section 25.208 are met without using geostationary satellite orbit arc avoidance. In addition, each NGSO FSS applicant must provide the orbital parameters contained in Section A.3 of Annex 1 to Resolution 46. Further, each NGSO FSS applicant must provide a sufficient technical showing to demonstrate that the proposed non-geostationary satellite orbit system meets the power-flux density limits contained in Section 25.208, as applicable.
- (d) Considerations involving transfer or assignment applications.
- (1) "Trafficking" in bare licenses issued pursuant to paragraph (b) of this section is prohibited, except with respect to licenses obtained through a competitive bidding procedure.
  - (2) The Commission will review a proposed transaction to determine if the circumstances indicate trafficking in licenses whenever applications (except those involving *pro forma* assignment or transfer of control) for consent to assignment of a license, or for transfer of control of a licensee, involve facilities licensed pursuant to paragraph (b) of this section. At its discretion, the Commission may require the submission of an affirmative, factual showing (supported by affidavits of a person or persons with personal knowledge thereof) to demonstrate that no trafficking has occurred.
- (e) Prohibition of certain agreements. No license shall be granted to any applicant for a NGSO system in the fixed-satellite service operating in the frequency bands referred to in (a) if that applicant, or any persons or companies controlling or controlled by the applicant, shall acquire or enjoy any right, for the purpose of handling traffic to or from the United States, its territories or possession, to construct or operate space segment or earth stations, or to interchange traffic, which is denied to any other United States company by reason of any concession, contract, understanding, or working arrangement to which the Licensee or any

persons or companies controlling or controlled by the Licensee are parties.

(f) **Implementation Milestone Schedule.** Each NGSO FSS licensee in the frequency bands referred to in (a) will be required to begin construction of its first two satellites within one year of the unconditional grant of its authorization, and complete construction of those first two satellites within four years of that grant. Construction of the remaining authorized operating satellites in the constellation must begin within three years of the initial authorization, and the entire authorized system must be operational within six years.

(g) **Reporting Requirements.** All NGSO FSS licensees in the frequency bands referred to in (a) shall, on June 30 of each year, file a report with the International Bureau and the Commission's Laurel, Maryland field office containing the following information:

- (1) Status of space station construction and anticipated launch date, including any major problems or delay encountered;
- (2) A listing of any non-scheduled space station outages for more than thirty minutes and the cause(s) of such outages; and
- (3) Identification of any space station(s) not available for service or otherwise not performing to specifications, the cause(s) of these difficulties, and the date any space station was taken out of service or the malfunction identified.

(h) **Financial Requirements.** Each NGSO FSS applicant must demonstrate, on the basis of the documentation contained in its application, that it is financially qualified to meet the estimated costs of the construction and launch of all proposed space stations in its system and the estimated operating expenses for one year after the launch of the initial system. Financial qualifications must be demonstrated in the form specified in § 25.140(c) and (d). In addition, applicants relying on current assets or operating income must submit evidence of a management commitment to the proposed satellite system. Failure to make such a showing will result in the dismissal of the application.

(i) **Replacement of Space Stations within the System License Term.** Licensees of NGSO FSS systems in the frequency bands referred to in (a) authorized through a blanket license pursuant to paragraph (a) of this section need not file separate applications to launch and operate technically identical replacement satellites within the term of the system authorization. However, the licensee shall certify to the Commission, at least thirty days prior to launch of such replacement(s) that:

- (1) The licensee intends to launch a space station that is technically identical to those authorized in its system authorization, and
- (2) Launch of this space station will not cause the licensee to exceed the total number of operating space stations authorized by the Commission.

(j) **In-Orbit Spares.** Licensees need not file separate applications to operate technically identical in-orbit spares authorized as part of the blanket license pursuant to paragraph (a) of this section. However, the licensee shall certify to the Commission, within 10 days of

bringing the in-orbit spare into operation, that operation of this space station did not cause the licensee to exceed the total number of operating space stations authorized by the Commission.

3. § 25.201 is amended by adding the following definition:

§ 25.201 Definitions.

\* \* \* \* \*

*Gateway earth station complex.* Gateway earth station complexes are not intended to originate or terminate traffic but are primarily intended for interconnecting to other networks. A gateway earth station complex may include multiple antennas, each required to meet the antenna performance standard in Section 25.209(h), located within a one second latitude and longitude square.

\* \* \* \* \*

4. § 25.202 is amended by adding the 10.7-10.95 GHz, 11.2-11.45 GHz and 12.2-12.7 GHz frequency bands, space-to-Earth, and the 12.75-13.25 GHz and 13.8-14.0 GHz frequency bands, Earth-to-space, in the table in (a)(1), and amending the associated footnotes, as follows:

§ 25.202 Frequencies, frequency tolerance and emission limitations.

\* \* \* \* \*

Space-to-Earth  
10.7-11.7 GHz<sup>1,2</sup>  
12.2-12.7 GHz<sup>x</sup>

Earth-to-Space  
12.75-13.25 GHz  
13.8-14.0 GHz

\* \* \* \* \*

<sup>2</sup> Use of this band by the GSO fixed-satellite service is limited to international systems....

<sup>3</sup> Use of this band by GSO fixed-satellite service in Region 2 is limited to national and subregional systems....

<sup>x</sup> Use of this band by the fixed-satellite service is limited to non-geostationary satellite orbit systems, with the exception of operation pursuant to international footnote S5.492/846.

\* \* \* \* \*



5. § 25.203 is amended by adding new paragraph (k) to read as follows:

§ 25.203 Choice of sites and frequencies.

\* \* \* \* \*

(k) NGSO FSS applicants shall be licensed to operate in the 10.7-11.7 GHz band for space-to-Earth transmissions to gateway earth station complexes and in the 12.75-13.25 GHz and 13.8-14.0 GHz bands for Earth-to-space transmissions from gateway earth station complexes. There shall be only one gateway earth station complex within each NGSO spacecraft antenna beam. These gateway earth stations shall not be located within a radius of 100 km around the city center of the 50 most populated cities in the United States, as defined by the 1990 Census. This non-implementation zone for the gateway earth stations will be eliminated by December 31, 20xx.

\* \* \* \* \*

6. § 25.204 is amended by adding a new paragraph (g) to read as follows:

§ 25.204 Power limits.

\* \* \* \* \*

(g) The level of equivalent isotropically radiated power (e.i.r.p.) emitted by an earth station transmitting to GSO FSS satellites in the frequency bands 12.75-13.25 GHz, 13.8-14.0 GHz and 14.0-14.5 GHz, except for telecommand and ranging functions, which may exceed these levels by X dB in normal mode and do not have to meet these limits for emergency mode, shall not exceed the following values for any off-axis angle,  $\theta$ , which is 2.5 degrees or more off the mainlobe axis of an earth station antenna, within  $\pm 3^\circ$  of the GSO:

<u>Off-axis angle (degrees)</u>	<u>Maximum e.i.r.p. density (dBW/40 kHz)</u>
$2.5^\circ \leq \theta < 7.0^\circ$	$39-25 \log (\theta)$
$7.0^\circ < \theta \leq 9.2^\circ$	18.0
$9.2^\circ < \theta \leq 48.0^\circ$	$42-25 \log (\theta)$
$48.0^\circ < \theta \leq 180.0^\circ$	0.0

For FM-TV emissions with energy dispersal, the above limits may be exceeded by up to 3 dB provided that the off-axis e.i.r.p. of the transmitted FM-TV carrier does not exceed the following values:

<u>Off-axis angle (degrees)</u>	<u>Maximum e.i.r.p. (dBW)</u>
$2.5^\circ \leq \theta < 7.0^\circ$	$53-25 \log (\theta)$
$7.0^\circ < \theta \leq 9.2^\circ$	32.0

$9.2^\circ < \theta \leq 48.0^\circ$	$56-25 \log(\theta)$
$48.0^\circ < \theta \leq 180.0^\circ$	14.0

FM-TV carriers which operate without energy dispersal should be modulated at all time with program material of appropriate test pattern. In this case, the off-axis total e.i.r.p. of the emitted FM-TV carrier shall not exceed the following values:

<u>Off-axis angle (degrees)</u>	<u>Maximum e.i.r.p. (dBW)</u>
$2.5^\circ \leq \theta < 7.0^\circ$	$53-25 \log(\theta)$
$7.0^\circ < \theta \leq 9.2^\circ$	32.0
$9.2^\circ < \theta \leq 48.0^\circ$	$56-25 \log(\theta)$
$48.0^\circ < \theta \leq 180.0^\circ$	14.0

7. § 25.208 is amended by modifying paragraph (b) (modifications shown as underlined text) and adding new paragraph (d) to read as follows:

§ 25.208 Power flux-density limits.

\* \* \* \* \*

(b) In the bands 10.95-11.2 and 11.45-11.7 GHz for GSO FSS space stations and 10.7-11.7 GHz for NGSO FSS space stations, the power flux density at the Earth's surface produced by emissions from a space station for all conditions and for all methods of modulation shall not exceed the following values:

- 150 dB(W/m<sup>2</sup>) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;
- 150+ ( $\delta$  -5)/2dB(W/m<sup>2</sup>) in any 4 kHz band for angles of arrival  $\delta$  (in degrees) between 5 and 25 degrees above the horizontal plane; and
- 140 dB(W/m<sup>2</sup>) in any 4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane

These limits relate to the power flux density which would be obtained under assumed free-space propagation conditions.

\* \* \* \* \*

(d) (1) In the 10.7-11.7 GHz, 11.7-12.2 GHz and 12.2-12.7 GHz frequency bands, the equivalent power-flux density<sup>173</sup>, at any point on the Earth's surface visible from the

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<sup>173</sup> The equivalent power flux-density is defined as the sum of the power flux-densities produced at a point of the Earth's surface by all space stations within a non-geostationary-satellite system, taking into account the off-axis discrimination of a reference receiving antenna assumed to be pointing towards the geostationary-satellite orbit. The equivalent power flux-density is calculated using the following formula:

geostationary-satellite orbit, produced by emissions from all the space stations of a non-geostationary-satellite system operating in the fixed-satellite service, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limits given in Tables XX and YY for the given percentages of time. These limits relate to the equivalent power flux-density which would be obtained under free-space propagation conditions, into a reference antenna and in the reference bandwidth as specified in Tables XX and YY, for all pointing directions towards the geostationary-satellite orbit.

Table XX

Frequency Band (GHz)	Equivalent pfd dB (W/m <sup>2</sup> ) <sub>(epfd)</sub>	Percentage of time during which equivalent pfd level may not be exceeded	Reference bandwidth (kHz)	Reference antenna diameter, and reference radiation pattern
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$$epfd = 10 * \log_{10} \left[ \sum_{i=1}^{N_s} 10^{pfd_i/10} * \frac{G_r(\theta_i)}{G_{max}} \right]$$

where:

- $N_s$  is the number of non-geostationary space stations visible from the point considered at the Earth's surface, within an elevation angle greater than or equal to 0°;
- $i$  is the index of the non-geostationary space station considered;
- $pfd_i$  is the power flux-density produced at the point considered at the Earth's surface in dB(W/m<sup>2</sup>) in the reference bandwidth;
- $\theta_i$  is the angle between the direction considered towards the geostationary-satellite orbit and the direction of the interfering space station in the non-geostationary-satellite system;
- $G_r(\theta_i)$  is the gain (as a ratio) of the receive reference antenna to be considered as part of a geostationary-satellite network;
- $G_{max}$  is the maximum gain (as a ratio) of the above receive reference antenna;
- $epfd$  is the computed equivalent power flux-density in dB(W/m<sup>2</sup>) in the reference bandwidth.

10.7-12.2	-X	99.7	4	60 cm, Rec. ITU-R S.465-5
	-X	99.9	4	3 m, Rec. ITU- R S.465-5
	-X	99.97	4	3 m, Rec. ITU- R S.465-5
	-X	99.97	4	10 m, Rec. ITU- R S.465-5
	-X	99.999	4	60 cm, Rec. ITU-R S.465-5
	-X	99.999	4	3 m, Rec. ITU- R S.465-5
	-X	99.999	4	10 m, Rec. ITU U-R S.465-5
	-X	100	4	≥60c m, Rec. ITU-R S.465-5

Table YY

FREQUENCY BAND ALLOCATED TO THE BSS	ANTENNA DIAMETER (CM)	EQUIVALENT PFD LEVEL (dB(W/M2/4kHz)) WHICH MAY NOT BE EXCEEDED DURING THE PERCENTAGE OF TIME SHOWN		REFERENCE ANTENNA RADIATION PATTERN
		99.7%	100%	
12.2 - 12.7 GHz	45	X	X	SECTION 3.7.2 OF ANNEX 5 OF APPENDIX 30 <sup>174</sup>
	100	X	X	
	120	X	X	
	180	X	X	

(2) In the 12.75-13.25 GHz and 13.8-14.5 GHz frequency bands, the aggregate power-flux density<sup>175</sup> produced at any point in the geostationary-satellite orbit by the emissions from all

<sup>174</sup> This is the reference antenna pattern for a one meter BSS receive earth station that was used in devising the original Region 2 BSS Plan in 1983.

<sup>175</sup> The aggregate power flux-density is defined as the summation of the power flux-densities produced at a point in the geostationary-satellite orbit by all the earth stations of a non-geostationary-satellite system. The aggregate power flux-density is computed by means of the following formula:

$$apfd = 10 \cdot \log_{10} \left[ \sum_{i=1}^{N_e} 10^{\frac{P_i}{10}} \cdot \frac{G_i(\theta_i)}{4 \cdot \pi \cdot d_i^2} \right]$$

where:

- $N_e$  is the number of earth stations in the non-geostationary-satellite system with an elevation angle greater than or equal to  $0^\circ$ , from which the point considered in the geostationary-satellite orbit is visible;
- $i$  is the index of the earth station considered in the non-geostationary-satellite system;
- $P_i$  is the RF power at the input of the transmitting antenna of the earth station considered in the non-geostationary-satellite system in dBW in the reference bandwidth;
- $\theta_i$  is the off-axis angle between the boresight of the earth station considered in the non-geostationary-satellite system and the direction of the point considered in the geostationary-satellite orbit;
- $G_i(\theta_i)$  is the transmit antenna gain (as a ratio) of the earth station considered in the non-

the earth stations in a non-geostationary-satellite system in the fixed-satellite service, for all conditions and for all methods of modulation, shall not exceed the limits given in Table ZZ for the specified percentages of time. These limits relate to the power flux-density which would be obtained under free-space propagation conditions in the reference bandwidth specified in Table ZZ.

Table ZZ

Frequency Band (GHz)	Aggregate pfd dB (W/m <sup>2</sup> ) (apfd)	Percentage of time during which aggregate pfd level may not be exceeded	Reference bandwidth (kHz)
12.75-13.25 and 13.8-14.5	-X	100	4
	-X	100	4

8. § 25.209 is amended by modifying paragraph (a) and adding new paragraphs (h) and (i) to read as follows:

§ 25.209 Antenna performance standards.

(a) .....except for antennas of earth stations with non-geostationary satellite orbit systems operating in the fixed-satellite service in the 10.7-11.7 GHz, 11.7-12.2 GHz, 12.2-12.7 GHz, 12.75-13.25 GHz, and 13.8-14.0 GHz, and 14.0-14.5 GHz frequency bands.

\* \* \* \*

(h) Gateway earth station antennas operating in the frequency bands 10.7-11.7 GHz, 12.75-

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geostationary-satellite system in the direction of the point considered in the geostationary-satellite orbit;

- $d$ , is the distance in metres between the earth station considered in the non-geostationary-satellite system and the point considered in the geostationary-satellite orbit;
- $apfd$  is the aggregate power flux-density in dB(W/m<sup>2</sup>) in the reference bandwidth.

13.25 GHz, 13.8-14.0 GHz and communicating with NGSO FSS satellites shall have the following antenna performance. Outside of the main beam, the gain of the antenna shall lie below the envelop defined by:

$$\begin{array}{ll} 29 - 25\log_{10}(\theta) \text{ dBi} & 1^\circ \leq \theta < 36^\circ \\ -10 \text{ dBi} & 36^\circ \leq \theta \leq 180^\circ \end{array}$$

where  $\theta$  is the angle in degrees from the axis of the main lobe, and dBi refers to dB relative to an isotropic radiator. For the purposes of this section, the peak gain of an individual sidelobe may not exceed the envelope defined above.

(i) Earth station antennas operating in the frequency bands 11.7-12.2 GHz, 12.2-12.7 GHz, 14.0-14.5 GHz and communicating with NGSO FSS satellites shall have the following antenna performance. Outside of the main beam, the gain of the antenna shall lie below the envelop defined by:

$$\begin{array}{ll} 32 - 25\log_{10}(\theta) \text{ dBi} & 1^\circ \leq \theta \leq 48^\circ \\ -10 \text{ dBi} & 48^\circ < \theta \leq 180^\circ \end{array}$$

where  $\theta$  is the angle in degrees from the axis of the main lobe, and dBi refers to dB relative to an isotropic radiator. For the purposes of this section, the peak gain of an individual sidelobe may not exceed the envelope defined above.

9. § 25.210 is amended as follows (modifications shown as underlined text):

§ 25.210 Technical requirements for space stations in the Fixed-Satellite Service

\* \* \* \* \*

(b) All GSO space stations in the Fixed-satellite service shall ...a range of 12 dB.

\* \* \* \* \*

10. § 25.212 is amended as follows (modifications shown as underlined text):

§ 25.212 Narrowband transmissions in the GSO Fixed-Satellite Service.

\* \* \* \* \*

## APPENDIX B INITIAL REGULATORY FLEXIBILITY ANALYSIS

As required by the Regulatory Flexibility Act ("RFA"),<sup>176</sup> the Commission has prepared this Initial Regulatory Flexibility Analysis ("IRFA") of the possible significant economic impact on small entities by the policies and rules proposed in this Notice of Proposed Rulemaking ("Notice"). Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments on the Notice provided above. The Commission will send a copy of the Notice, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration. *See* 5 U.S.C. § 603(a). In addition, the Notice and IRFA (or summaries thereof) will be published in the Federal Register.

### **Need for, and Objectives of, the Proposed Rules.**

We undertake this proceeding to address the spectrum sharing issues presented by SkyBridge's and Northpoint's proposed use of spectrum in the Ku-band frequency range. These proposals could increase competition and provide new advanced services to the public. Specifically, SkyBridge's proposal could provide new high-speed data services and offer additional competition to other satellite services, and terrestrial wireless and wireline services. Similarly, Northpoint's proposal could provide local video and new data services and facilitate competition to cable television systems. There is, however, extensive use of the requested frequency bands in the U.S. and these incumbent operations provide important and valuable services to the public. While we desire to promote competition and innovation by allowing for new services or additional spectrum use, we also need to consider the competing interests of the incumbent services in these bands.

Therefore, we propose to permit non-geostationary satellite orbit ("NGSO") fixed-satellite service ("FSS") operations<sup>177</sup> in certain segments of the Ku-band<sup>178</sup> and propose rules and policies

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<sup>176</sup> *See* 5 U.S.C. § 603. The RFA, *see*, 5 U.S.C. § 601 *et seq.*, has been amended by the Contract With America Advancement Act of 1996, Pub. L. No. 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

<sup>177</sup> NGSO satellite systems, such as proposed by SkyBridge, are characterized by a constellation of satellites continuously orbiting the earth, rather than appearing to remain stationary relative to a user as a geostationary satellite does. NGSO satellites operate at lower altitudes and therefore appear to move from horizon to horizon. As the NGSO satellites move through their orbit, they transmit to and receive from earth stations that are in view of the satellite. Geostationary satellites orbit 22,300 miles above the Earth in the plane of the Earth's equator. At this altitude, the geostationary satellite's position appears fixed relative to an observer on the Earth.



to govern such operations. We also propose or ask for comment on technical criteria to ensure that such NGSO FSS operations do not cause harmful interference to existing users or do not unduly constrain future growth of incumbent services. Specifically, we ask whether the spectrum sharing criteria developed at the 1997 International Telecommunication Union ("ITU") World Radiocommunication Conference ("WRC-97")<sup>179</sup> are adequate to permit NGSO FSS operations in various segments of the Ku-band or whether other criteria are needed to protect incumbent users. In addition, we ask for comment on a proposal to permit terrestrial use of the 12.2-12.7 GHz band for the retransmission of local television and provision of one-way data services by direct broadcast satellite ("DBS") service operators and their affiliates.

### **Legal Basis.**

The proposed action is authorized under Sections 4(i), 7(a), 303(c), 303(f), 303(g), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 157(a), 303(c), 303(f), 303(g), and 303(r).

### **Description and Estimate of the Number of Small Entities To Which the Proposed Rules May Apply.**

Skybridge has requested that the Commission amend Parts 2 and 25 of its rules to permit NGSO FSS systems to operate in the United States ("U.S.") in the 10.7-12.7 GHz band for NGSO space-to-earth links ("downlinks") (a total of 2 gigahertz) and in the 12.75-13.25 GHz, 13.75-14.5 GHz, and 17.3-17.8 GHz bands for NGSO earth-to-space links ("uplinks") (a total of 1.75 gigahertz). The requested downlink bands are generally used by geostationary-satellite orbit ("GSO") FSS, DBS and fixed services. The requested uplink bands are used by GSO FSS operations, fixed services, mobile services, and Government operations.

The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."<sup>180</sup> In addition, the term "small business" has the same meaning as the term "small business concern"

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<sup>178</sup> The Ku-band generally refers to frequencies within the 12 GHz to 18 GHz range. The specific bands subject to this proceeding are the 10.7-12.7 GHz, 12.75-13.25 GHz, 13.75-14.5 GHz, and 17.3-17.8 GHz bands. For the purposes of this proceeding, we use the term "Ku-band" to refer generally to all of the frequency bands listed above that are under consideration in this proceeding.

<sup>179</sup> See *Final Acts of the 1997 World Radiocommunication Conference ("Final Acts of WRC-97")*; Article S21, Article S22, Resolution 130, Resolution 131, Resolution 538 (*Geneva, 1997*).

<sup>180</sup> *Id.* § 601(6).

under the Small Business Act.<sup>181</sup> A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration ("SBA").<sup>182</sup> A small organization is generally "any not-for-profit enterprise which is independently owned and operated and is not dominant in its field."<sup>183</sup>

Regarding incumbent cable television operations in the 12.75-13.25 GHz band, the SBA has developed a definition of small entities for cable and other pay television services, which includes all such companies generating \$11 million or less in revenue annually. This definition includes cable systems operators, closed circuit television services, direct broadcast satellite services, multipoint distribution systems, satellite master antenna systems and subscription television services. According to the Census Bureau, there were 1,788 total cable and other pay television services and 1,423 had less than \$11 million in revenue.

The Communications Act also contains a definition of a small cable system operator, which is "a cable operator that, directly or through an affiliate, serves in the aggregate fewer than 1 percent of all subscribers in the United States and is not affiliated with any entity or entities whose gross annual revenues in the aggregate exceed \$250,000,000." The Commission has determined that there are 61,700,000 subscribers in the United States. Therefore, we found that an operator serving fewer than 617,000 subscribers shall be deemed a small operator, if its annual revenues, when combined with the total annual revenues of all of its affiliates, do not exceed \$250 million in the aggregate. Based on available data, we find that the number of cable operators serving 617,000 subscribers or less totals 1,450. We do not request nor do we collect information concerning whether cable system operators are affiliated with entities whose gross annual revenues exceed \$250,000,000, and thus are unable at this time to estimate with greater precision the number of cable system operators that would qualify as small cable operators under the definition in the Communications Act.

Regarding incumbent DBS operations in the 12.2-12.7 GHz band, because DBS provides subscription services, DBS falls within the SBA definition of Cable and Other Pay Television Services (SIC 4841). This definition provides that a small entity is expressed as one with \$11.0 million or less in annual receipts. As of December 1996, there were eight DBS licensees. However, the Commission does not collect annual revenue data for DBS and, therefore, is unable to ascertain the number of small DBS licensees that could be impacted by these proposed rules.

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<sup>181</sup> 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in 15 U.S.C. § 632). Pursuant to the RFA, the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register." 5 U.S.C. § 601(3).

<sup>182</sup> Small Business Act, 15 U.S.C. § 632 (1996).

<sup>183</sup> 5 U.S.C. § 601(4).

Although DBS service requires a great investment of capital for operation, we acknowledge that there are several new entrants in this field that may not yet have generated more than \$11 million in annual receipts, and therefore may be categorized as a small business, if independently owned and operated.

Regarding incumbent GSO FSS satellite use and the proposed NGSO FSS use in these requested bands, the Commission has not developed a definition of small entities applicable to geostationary or non-geostationary orbit fixed-satellite service applicants or licensees. Therefore, the applicable definition of small entity is the definition under the Small Business Administration (SBA) rules applicable to Communications Services, Not Elsewhere Classified. This definition provides that a small entity is one with \$11.0 million or less in annual receipts.<sup>184</sup> According to Census Bureau data, there are 848 firms that fall under the category of Communications Services, Not Elsewhere Classified which could potentially fall into the geostationary or non-geostationary orbit fixed-satellite service category. Of those, approximately 775 reported annual receipts of \$11 million or less and qualify as small entities.<sup>185</sup> Generally, these NGSO and GSO FSS systems cost several millions of dollars to construct and operate. Therefore the NGSO and GSO FSS companies, or their parent companies, rarely qualify under this definition as a small entity.

Regarding Auxiliary, Special Broadcast and other program distribution services in the Ku-band. This service involves a variety of transmitters, generally used to relay broadcast programming to the public (through translator and booster stations) or within the program distribution chain (from a remote news gathering unit back to the station). The Commission has not developed a definition of small entities applicable to broadcast auxiliary licensees. Therefore, the applicable definition of small entity is the definition under the Small Business Administration (SBA) rules applicable to radio broadcasting stations (SIC 4832) and television broadcasting stations (SIC 4833). These definitions provide, respectively, that a small entity is one with either \$5.0 million or less in annual receipts or \$10.5 million in annual receipts. 13 C.F.R. § 121.201, SIC CODES 4832 and 4833. There are currently 2,720 FM translators and boosters, 4,952 TV translators. The FCC does not collect financial information on any broadcast facility and the Department of Commerce does not collect financial information on these auxiliary broadcast facilities. We believe, however, that most, if not all, of these auxiliary facilities could be classified as small businesses by themselves. We also recognize that most translators and boosters are owned by a parent station which, in some cases, would be covered by the revenue definition of small business entity discussed above. These stations would likely have annual revenues that exceed the SBA maximum to be designated as a small business (as noted, either \$5 million for a radio station or \$10.5 million for a TV station). Furthermore, they do not meet the Small Business Act's definition of a "small business concern" because they are not independently owned

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<sup>184</sup> 13 C.F.R. § 121.201, Standard Industrial Classification (SIC) Code 4899.

<sup>185</sup> U.S. Bureau of Census, U.S. Department of Commerce, 1992 Census of Transportation, Communications, Utilities, UC92-S-1, Subject Series, Establishment and Firm Size, Table 2D, Employment Size of Firms: 1992, SIC Code 4899 (issued May 1995).

and operated.

Incumbent microwave services in the 10.7-11.7 GHz and 12.75-13.25 GHz bands, include common carrier, private operational fixed, and broadcast auxiliary radio services. At present, there are 22,015 common carrier licensees, approximately 61,670 private operational fixed licensees and broadcast auxiliary radio licensees in the microwave services. Inasmuch as the Commission has not yet defined a small business with respect to microwave services, we will utilize the SBA's definition applicable to radiotelephone companies -- i.e., an entity with no more than 1,500 persons. 13 C.F.R. § 121.201, SIC CODE 4812. We estimate, for this purpose, that all of the Fixed Microwave licensees (excluding broadcast auxiliary licensees) would qualify as small entities under the SBA definition for radiotelephone companies.

#### **Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements.**

We propose to apply the Part 25 rules governing reporting requirements for FSS systems. Specifically, licensees are required to file an annual report with the Commission describing: the status of satellite construction and anticipated launch dates, including any major delays or problems encountered; a listing of any unscheduled satellite outages for more than 30 minutes including the cause(s) of any such outages; and a detailed description of the utilization made of each satellite on each of the in-orbit satellites.

#### **Steps Taken to Minimize Significant Economic Impact on Small Entities, and Significant Alternatives Considered.**

We propose to adopt or seek comment on adequate spectrum sharing criteria to minimize the potential for interference of these new NGSO FSS operations on incumbent operations, many of which qualify as small entities. Further, to promote system growth for the fixed microwave service (which includes most of the small entities under consideration in this proceeding), we are proposing to establish exclusion areas around the top 50 cities in the U.S. which would not permit NGSO earth stations to construct in these areas for several years. This proposal should permit fixed service small entities some level of assurance that future fixed links could be established without hinderance from NGSO FSS earth stations. We request comment on other alternatives that could minimize the impact of this action on small entities.

#### **F. Federal Rules that May Duplicate, Overlap, or Conflict With the Proposed Rules**

None.

## APPENDIX C: Exclusion Area Maps.

The following data was obtain from the Census Bureau and is based on the 1990 Census April 1, 1990.

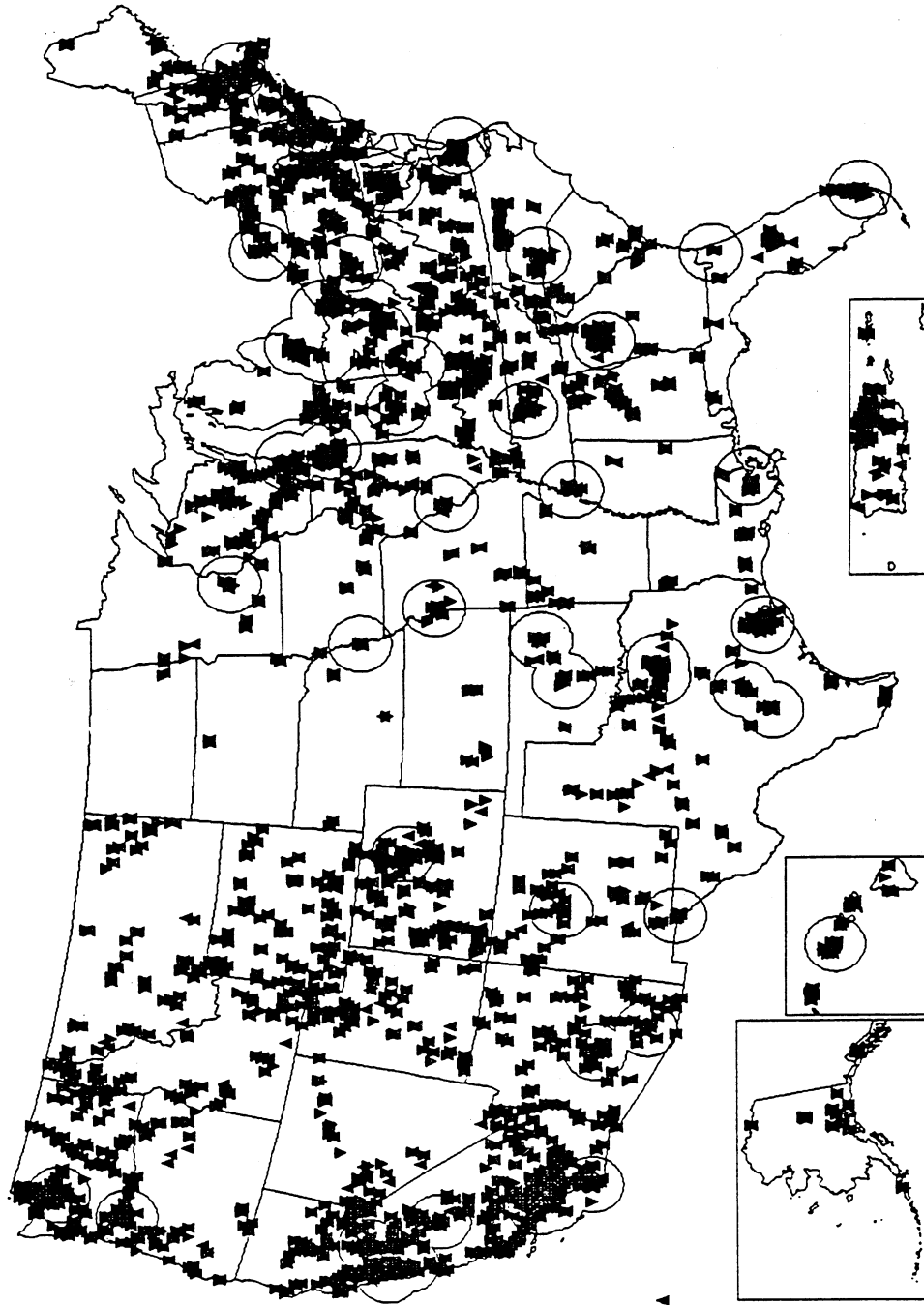
State	City	Rank	Population	Latitude	Longitude
NY	New York	1	7322564	40669800	73943849
CA	Los Angeles	2	3485398	34112101	118411201
IL	Chicago	3	2783726	41837050	87684965
TX	Houston	4	1630553	29768700	95386728
PA	Philadelphia	5	1585577	40006817	75134678
CA	San Diego	6	1110549	32814950	117135770
MI	Detroit	7	1027974	42383100	83102198
TX	Dallas	8	1006877	32794151	96765249
AZ	Phoenix	9	983403	33542550	112071399
TX	San Antonio	10	935933	29457650	98505355
CA	San Jose	11	782248	37304000	121849783
IN	Indianapolis	12	741952	39777700	86145999
MD	Baltimore	13	736014	39300800	76610616
CA	San Francisco	14	723959	37779040	122495856
FL	Jacksonville	15	672971	30334150	81648509
OH	Columbus	16	632910	39988933	82987381
WI	Milwaukee	17	628088	43063350	87966623
TN	Memphis	18	610337	35105600	90006991
DC	Washington	19	606900	38905050	77016167
MA	Boston	20	574283	42336029	71017892
WA	Seattle	21	516259	47621800	122350326
TX	El Paso	22	515342	31849250	106437549
TN	Nashville-Davidson	23	510784	36171550	86784829
OH	Cleveland	24	505616	41479700	81678511
LA	New Orleans	25	496938	30065846	89931355
CO	Denver	26	467610	39768035	104872655
TX	Austin	27	465622	30305880	97750522
TX	Fort Worth	28	447619	32753901	97336249
OK	Oklahoma City	29	444719	35467050	97513491
OR	Portland	30	437319	45538250	122656496
MO	Kansas City	31	435146	39122312	94552009
CA	Long Beach	32	429433	33788900	118159824

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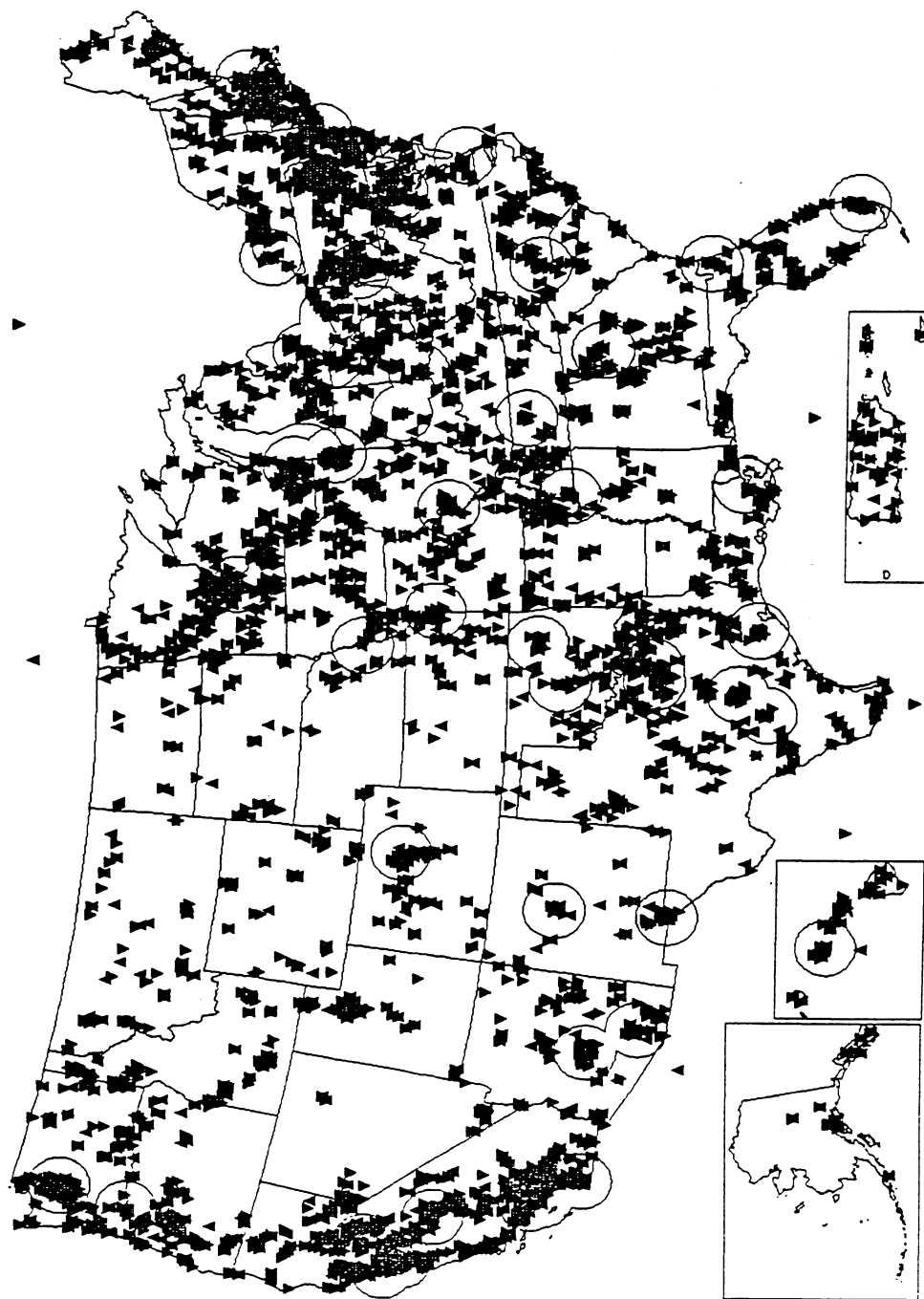
State	City	Rank	Population	Latitude	Longitude
AZ	Tucson	33	405390	32195816	110891717
MO	St. Louis	34	396685	38636050	90244299
NC	Charlotte	35	395934	35197550	80834514
GA	Atlanta	36	394017	33762900	84422592
VA	Virginia Beach	37	393069	36739356	76043668
NM	Albuquerque	38	384736	35117218	106624636
CA	Oakland	39	372242	37771544	122224550
PA	Pittsburgh	40	369879	40439207	79976702
CA	Sacramento	41	369365	38566850	121467360
MN	Minneapolis	42	368383	44961850	93266849
OK	Tulsa	43	367302	36127750	95916407
HI	Honolulu CDP	44	365272	21317250	157804233
OH	Cincinnati	45	364040	39139801	84505957
FL	Miami	46	358548	25775667	80210845
CA	Fresno	47	354202	36780600	119792874
NE	Omaha	48	335795	41263900	96011745
OH	Toledo	49	332943	41663950	83581649
NY	Buffalo	50	328123	42889800	78859684

Longitude and latitude coordinates are expressed in millionths of a degree. Coordinate values are based on Clarke's spheroid of 1866, also referred to as the North American Datum, 1927 (NAD27).

Below are two graphical depictions of the incumbent terrestrial operations in the 10.7-11.7 GHz and 12.7-13.25 GHz bands, with an overlay of the exclusion areas proposed for the 10.7-11.7 GHz band.



10700 - 11700 MHz



12700 - 13250 MHz



**Separate Statement  
of  
Commissioner Susan Ness**

*Re: Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of  
NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band  
Frequency Range*

With this Notice of Proposed Rulemaking, the Commission opens the door for more competitors to provide services in the Ku-band spectrum for the benefit of the American public. This Notice explores other ways for multiple non-geostationary satellite systems to share the limited spectrum in the Ku-band with existing geostationary satellite, terrestrial and government systems to maximize use of the radio spectrum without interfering with existing users. I write separately to caution that whatever spectrum sharing criteria are finally adopted by the Commission for the Ku-band must not restrict the growth and evolution of existing geostationary and terrestrial systems operating in the frequency band.

I am also pleased that this rulemaking will contribute to, and benefit from, the work being done in the ongoing ITU Joint Task Group 4-9-11, which is evaluating the 1997 World Radiocommunication Conference provisional sharing limits applicable to satellite systems operating in the Ku-band. This work is invaluable as we forge ahead to stretch the limits of our radio spectrum to make possible the delivery of more efficient and innovative communications services for consumers around the world.